Compressed Air

A MONTHLY MAGAZINE DEVOTED TO THE USEFUL APPLICATION OF COMPRESSED AIR.

VOL. VIII. NEW YORK, JULY, 1903. No. 5.

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OR

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A MONTHLY PUBLICATION DEVOTED TO THE USEFUL APPLICATION OF COMPRESSED AIR.

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Compressed Air and Steam.

The superiority of compressed air over steam on contract work has already been successfully demonstrated, although all advocates of steam are not willing to admit it. It is pleasant, however, for those who know such to be the case to have their knowledge completely and unqualifiedly endorsed by such a conservative and reliable journal as the *Engineering News.* That publication takes a definite stand on the subject in a recent article which is re-published in another column of this number. While it is no great discovery on the part of the *Engineering News,* it serves to show that the whole engineering world will soon have to admit the advantages of compressed air in this direction at least.

Had it been deemed advisable it would have been easy to tell of a number of central power plants where compressed air has been used with great success in contract work. In the vicinity of New York no better illustration can be found than the plant erected by MacDonald & Onderdonk to assist in the construction of the Jerome Park reservoir.

The *Engineering News* might have added that compressed air was much superior to steam in many cases,where the work was not on contract but of a more permanent nature, as in quarries and mines. While its usefulness in quarries has long ago been conceded, many quarrymen have delayed the introduction of a central compressed air power plant on account of the initial cost and the necessity of abandoning their present machinery, which, while still serviceable, is, after all, of an antiquated type.

Most important and significant, therefore, is the recent decision of the Cleveland Stone Co. to establish a compressed air power plant at its North Amherst quarry, one of the largest in the world. This concern believes by the change that it will secure an increased output at a reduced cost. This action promises to be of special importance in quarrying circles all over the United States, and if it is a success, as we confidently predict, it will undoubtedly mean that owners of other quarries throughout the land will pursue a similar course and manufacturers of compressed air machinery will reap the harvest which will inevitably follow. While it will mean increased business for them, it will benefit the quarrymen, besides giving the public the stone more speedily and at a reduced cost.

Cleveland Stone Company's New Power Plant.

Mention has already been made of the order which the Cleveland Stone Company has given to The Ingersoll-Sergeant Drill Company for a complete compressed air power plant for its No. 6 quarry at North Amherst, O., one of the largest in the world.

The installation of this plant promises to be of special importance in quarrying circles, as it marks a distinct step in the history of compressed air for quarry work on a large scale. While the stone company supplies the foundations, building, and does the excavating, The Ingersoll-Sergeant Drill Company will furnish the complete plant in running order. As it was a very large venture and required a concern of high standing and much experience to successfully handle it, the fact that the order was given in the end practically without competition shows a pleasing recognition of that company's ability to cope with it.

The plant is to consist of two large Ingersoll-Sergeant Corliss condensing air compressors, 48 inch stroke, semi-tangye frames, having a combined capacity of 9,215 cubic feet free air per minute, steam and air ends compounded and of the highest refinement in economy throughout; also three Stirling water tube boilers, 258 rated horse power each, to carry 180 pounds working steam pressure; two independent jet condensers; two duplex boiler feed pumps; two duplex auxiliary low service pumps; three Roney mechanical stokers; one fan draft; water purifier system, etc., including some 10,000 feet of large air pipe and fittings as the main feeder around the quarry.

Among the machinery to be handled are nine very powerful hoisting stations, handling 22 derricks, some 15 channeling machines, 15 rock drills, pumps, blacksmith fires, steam hammers, grindstone and shop engine.

So many radical changes in the whole system of quarrying are in contemplation that it is claimed the output will be increased from 25 to 50 per cent. with the same labor force, while the coal consumption will be cut down two-thirds and the cost of production cheapened to a very material extent. It is said that this plant will give a cubic foot of air at less cost than any other plant in the world. It is expected that this new plant will be in operation by September next. Its completion will be awaited with more than the usual interest, as its success will undoubtedly lead other concerns to follow the example.

While compressed air has been used to a greater or less degree in stone quarrying, there is no quarry the size of the one at North Amherst which posseses a complete compressed air power plant. It cannot be regarded in the light of an experiment, however, as the smaller plants have already successfully demonstrated the success of compressed air in work of that nature.

The Advantages of Compressed Air over Steam on Contract Work.

We are accustomed to seeing a multitude of small steam boilers and engines on large contract jobs where derricks, concrete mixers, and drills are used. The saving in dollars and cents to be derived by the substitution of compressed air for steam on such works will be outlined in this article. To begin with there is always a large saving of coal where one large power generating plant is used in place of many smaller ones. Even well-informed contractors are not always aware of the extreme wastefulness of the small engine. Thus an 8-H. P. engine and boiler on a derrick may readily consume 800 lbs. of coal per 10-hour day, or 10 lbs. of coal per H. P. per hour; whereas an 80-H. P. engine will require only 4 or 5 lbs. to coal per H. P. per hour. Great as is the possible saving in the fuel item it by no means equals the saving in fireman's wages. One fireman can readily stoke a 100-H. P. boiler, yet where the engineman is kept at all busy on derrick work, there must be a fireman for every small boiler no matter how small it is. It is not uncommon, therefore, to see half a dozen firemen on a job where one would serve were he employed at a central plant.

Steam can, of course, be generated at a central plant and piped considerable distances, with increasing loss in steam pressure as the distance increases, even in summer months. In cold weather, long exposed steam pipes are entirely out of the question, hence we seldom see a central steam plant on contract work. But

with compressed air there is no loss of pressure in the pipes, except the slight loss due to friction. In very cold weather there is no freezing up of the air pipes, provided the air is cooled before it begins its journey, thus removing the excess of moisture at the compressor.

The compressed air tank or receiver is not a reservoir of power as is commonly supposed. If it were it would have to be an enormous affair, whereas a small boiler-like reservoir is all that is needed. The functions of this receiver are to collect the water and grease that the air carries, and to equalize the pulsations in the air coming intermittently from the compressor. On bridge work a portable air-compressor plant mounted upon a flat car is often used to compress air for the pneumatic riveters. A gasolene engine operates the compressor, so that no fireman at all is required, and no boiler water is needed. Very often this item of water is a very expensive one to the contractor, and here again is where the air compressor driven by a gasolene engine is decidedly economical.

Coming now to the engines and drills themselves, of course, it is apparent that any engine ordinarily run by steam can be run by compressed air. The most familiar type of engine used by many contractors either with air or with steam is the power drill, and there is probably no class of engine where it pays better to use air than the power drill. The flexible marlin or wire-wound rubber hose leading from the pipe line to the drill is "rotted out" by steam in an exceedingly short time, as contractors having to make frequent renewals of this expensive hose are well aware. Compressed air, however, has no such deleterious effect. There is a further gain in the cylinder oil account, since more oil is consumed where steam is used. The fact, that with air the cylinder of a power drill is always cool, is of advantage also in that the drill can be more readily handled and shifted about.

We have drawn no fanciful picture of what may be done with compressed air from a central plant. One contractor, we know, has a 125-H. P. boiler furnishing steam to an engine driving an air compressor which furnishes air to operate six power drills, three cableway engines, one concrete mixer engine and one derrick engine. The first cost of such a plant is actually less than the first cost of separate boilers for each of the engines enumerated, while the cost of repairs and maintenance is far less. But what is of even greater moment is the fact that the fuel item is cut in two, and the wages item of firing is one-fourth what it is when using separate steam boilers.

Compressed air lends itself also to a variety of uses not possible with steam. Thus where there is iron work going on near masonry or excavation, air may be used to run pneumatic riveters, and these same riveters provided with a cutting tool may be used to dress stone. Concrete might thus be cheaply dressed on the face, and so effect a roughened surface that would not show every slight stain or variation in color. Small pneumatic hoists, blowers on forges and many other machines about the work lend themselves to operation by compressed air more readily than by any other form of power.—*Engineering News.*

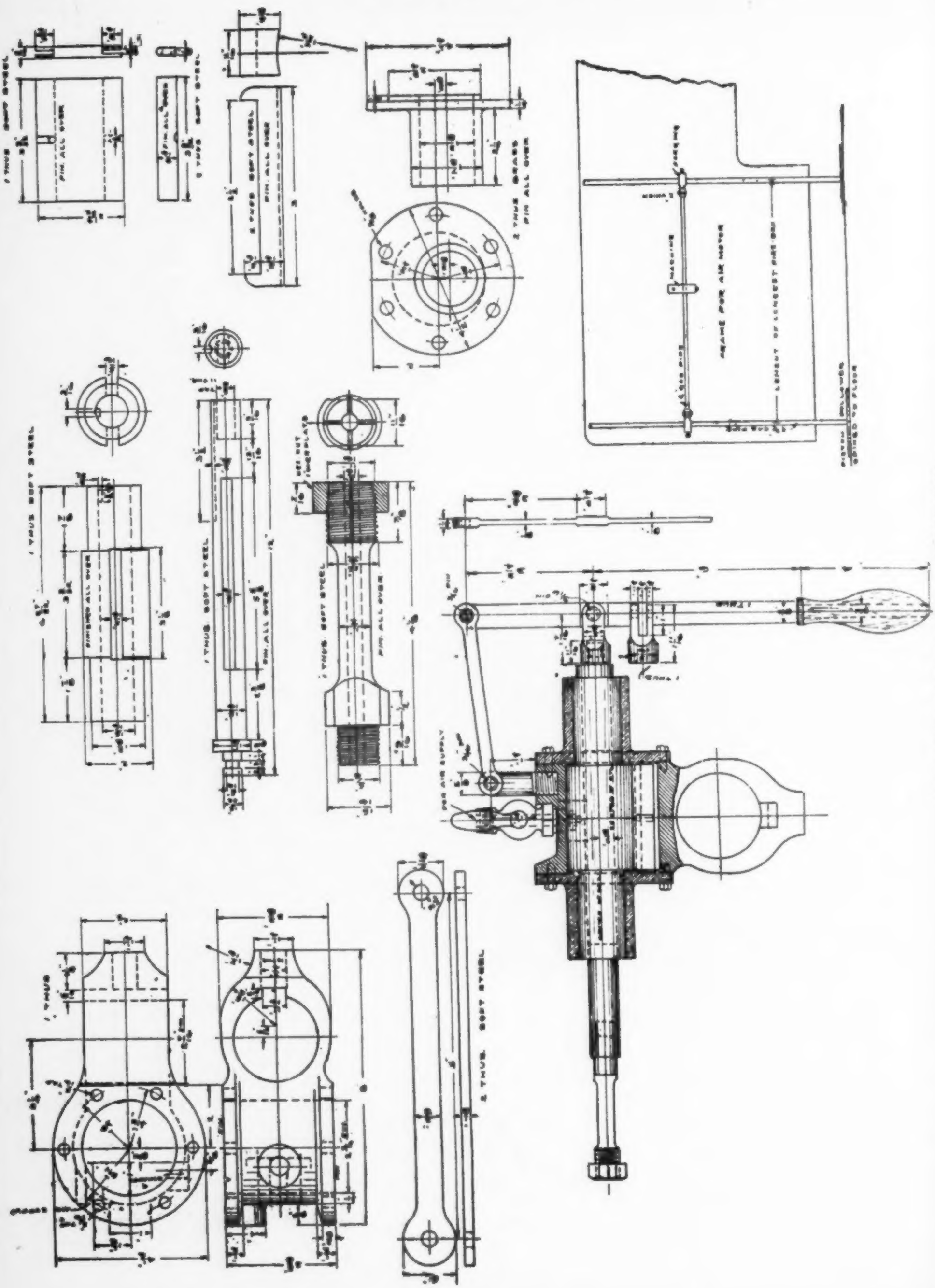
Air Motor for Drilling Staybolts.

The cut on page 2459 illustrates an interesting device for drilling telltale holes in staybolts. The apparatus is designed for use after the staybolts are in place. The machine is operated by air and is capable of drilling 36 staybolts per hour.

When in operation the machine is rigidly attached to a horizontal bar, which in turn is supported by two vertical members. The vertical supports are of 2½-inch gas pipe and the horizontal piece is of 2-inch pipe. In order that the horizontal bar may be raised and lowered to conform to the height of the rows of staybolts in the boiler, each end is attached by a 2-inch union to a forged lug which may be made to slip along the vertical piece and which is supplied with a set screw to hold it in any desired position when the proper adjustment has been made. The unions facilitate the dismembering of the parts of the supporting frame when not in use. In order that the frame may maintain a rigid, upright position, the vertical pieces terminate in wide bases, which may be spiked to the floor.

A lug is cast beneath the machine, which encircles the horizontal, or guide rod. A set screw maintains the position of the machine when adjusted.

The several parts of the machine are shown in detail and assembled. The center line of the drill is offset ⅜-inch from the



AIR MOTOR FOR DRILLING STAYBOLTS.

center line of the cylinder. The drill socket is applied to an arbor which extends throughout the length of the machine, terminating at the opposite end in a lug to which the feeding handle is attached. Revolving with, and about this arbor is a spindle, the diameter of the arbor being such as to allow it to slide longitudinally, without restraint, within given limits. This movement is given by the feeding handle, which is operated by hand.

Through the spindle is a 5-16-inch keyway 3 3-32 inches long, and through the arbor is a 5-16-inch keyway 5⅝ inches long. The keyways of the two are made to conform by a dowel pin. A steel feather 5-16 inch thick is inserted within the keyway thus made. In such a position with relation to the spindle and arbor the feather offers a surface to receive the force of air supplied through an airport passing through the walls of the cylinder. The force of the air against this feather rotates the spindle and arbor, thus giving impetus to the drill. In order that air may not leak past the edges of the feather, packing strips ⅛ inch thick are inserted.

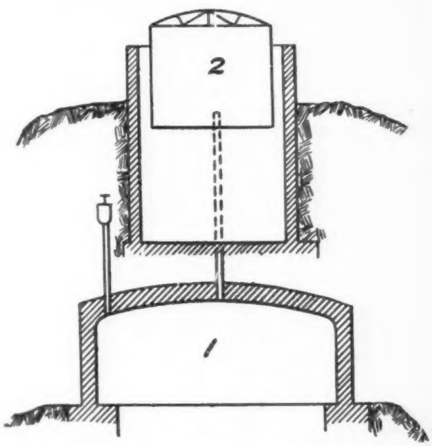
The offset of ⅜ inch between the center lines of the cylinder and the spindle exposes the surface of the feather, which extends beyond the diameter of the spindle, to the force of the air supplied. At the same time this offset is such as to cause the spindle to bear continually, though lightly, against the wall of the cylinder. This arrangement prevents the passage of air directly from the supply port to the exhaust port. Being thus obstructed across the shortest distance between the two ports, the air must pass around the spindle, and in so doing forces the feather around before it.

As explained above, the keyway through the arbor is longer than the keyway through the spindle and the arbor is of such diameter as to slide within the spindle. It is, therefore, evident that by operating the handle attached to the end of the arbor, the drill may be fed to or drawn away from the staybolt.

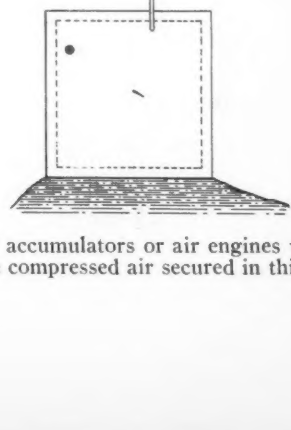
For the illustration presented herewith we acknowledge the courtesy of Mr. T. A. Lawes, superintendent of motive power and machinery of the Chicago & Eastern Illinois Railroad.—*Railway Master Mechanic.*

Utilizing Tidal Action.

Entirely new is the plan of Mr. Chas. Eugene Ongley, of Mons, Belgium, by which he proposes to utilize the rise of the tides for obtaining compressed air, which was noted editorially in the June



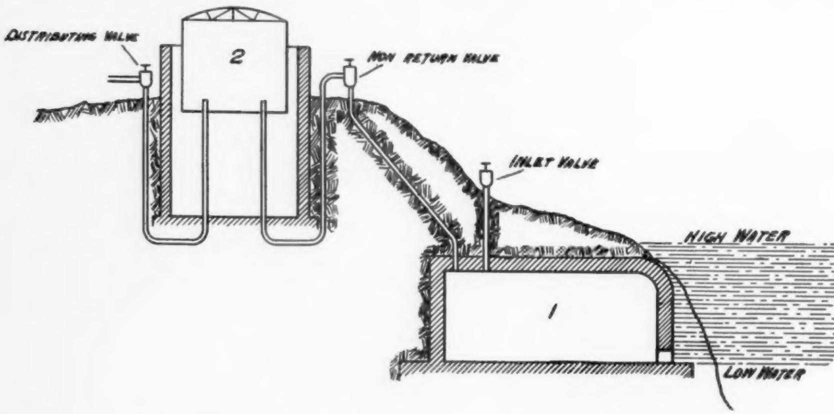
number of COMPRESSED AIR. While the inventor only claims to secure a comparatively slight pressure by his proposed method, he believes this pressure can be used to obtain higher pressures with the



aid of accumulators or air engines worked by the compressed air secured in this manner.

The important feature of this invention consists of compressing air with the aid of the rising tide and includes a tunnel and conduit conveniently arranged in relation to the shore and adapted to admit and to confine the air as the level of the water rises with the incoming tide. The inner end of the conduit is to be in connection with a reservoir in which the air may be collected.

As first planned the tunnel will be constructed as a subterranean passage, made of brick, at right angles to the shore line, opened at the shore end and practically closed at the other. The roof will increase in pitch from the shore end and inward, so as to confine the air at the opposite end as the water level rises. At the inner end of the tunnel is to be placed a non-return valve, the pipe from which will connect to a receiver. The diameter of the outer end of the tunnel is to be small compared with that of the inner end, and the air contained in the tunnel will be imprisoned by the closing of the other end of the rising tide, and the air contained in it will be compressed. Instead of increasing the pitch of the roof as described the inventor also suggests having a tower or shaft at the inner extremity of the tunnel. Means may also be provided for trapping the air contained within the tunnel and preventing its partial escape while the water is entering.



While the force of the tide is not sufficient to obtain any heavy pressures, it is the belief of the inventor that large amounts of air can be compressed to be used to secure higher compression of a less volume or for forge and cold storage purposes. It can also be transported.

The Pneumatic Tube System of a Modern Department Store.*

The use of pneumatic tubes in transmitting money, papers and parcels of various kinds has become so extensive that the service is considered a necessity in the equipment of the modern mercantile establishment. The plan is not a new one. Improvements, however, which have been made in the system in the last two or three years have greatly increased its practical value. In the dry goods or department store, for example, it is valuable as a labor saver, dispensing, as it does, with the many cash boys, in some instances cash girls, that have been employed, and performing their work much more quickly, besides avoiding many mistakes which formerly occurred. There is no delay in "making change," as the amount due the customer is usually handed him by the salesman within a minute, sometimes less than a minute, after his money has been taken over the counter. The system also assists in checking or auditing the sales, for the charge or cash slip which represents the amount of the transaction is sent to the cashier or book-

* By Day Allen Willey for *Scientific American*.

keeper, where it is examined and verified before being returned.

In the ordinary store the pneumatic tubes extend from the cashier's and bookkeeper's departments to the principal sales departments, varying, of course, in number according to the extent of the establishment. Each tube is termed a "line" and is usually 2¼ inches in diameter. The tubes are generally extended along the ceiling or under the floors for the purpose of economizing space, and the terminals where the carriers are received and sent are of various shapes adjusted to suit the conditions. The system is so laid out that when a sale is made the clerk prepares his purchase check, gets the money from the purchaser, and places it in a small brass cylinder which can be unscrewed at the end merely by a twist of the fingers. To start the carrier, it is necessary only to insert it in the receiving end. The air forces it through the line to what is called the main station. This is usually in the cashier's office, for so many articles in the retail store are sold for cash that no entry is required. The carrier drops into the open receiver at the end of the tube, from which it is taken by the "change maker," who, as already stated, glances over the figures on the slip and verifies the total. If an error has been made, the slip and money are returned to the department from which they were sent. If correct, the slip is returned with the amount due the customer. If the sale is to be charged, the slip of course contains the name of the customer in addition to a description of the article and the amount due. As soon as it has been examined, the clerk in the cashier's office again places it in the carrier and inserts it in the tube or line connected with the bookkeeper's department. Here the memorandum is taken out, entered on the books and either the original slip or a duplicate is returned to the salesman.

These operations are usually performed in less time than it takes to read the description; for the carrier travels at a rate varying from 1,000 to 2,500 feet per minute, according to the air current. The length of a line is seldom over 600 feet. The current is produced by the blower system, and the mechanical plant installed provides for a force representing from one-fourth to one-half horse power to each line, depending upon the number of bends or curves and the amount of service. A store having a "50-line" service therefore requires an engine of about twenty-five horse power. In some systems the blowers are operated by steam power direct, but electric motors, either direct connected or bolted to the blowers, are preferred.

The air current is maintained in the tube system in the following manner: The various lines are connected with what may be called a main conduit, which leads to the engine room and to the blowers. These blowers draw the air from the various sending terminals of the line, expelling it through a conduit of suitable size, which may open in the engine room or be connected with the street. While the velocity of the current varies according to the speed of the blower fans, the minimum is rarely less than 2,500 feet per minute, the pressure in the tubes ranging from 6 to 12 ounces per square inch, the latter pressure being secured with a service of one-half horse power. The principle is simply the exhaustion of the air in the tubes to produce a partial vacuum. The effect is so powerful that, although the carriers and their contents weigh a half pound, they are transported without difficulty. The suction is not apparent twelve inches from the end of the receiver. Consequently, the end of the receiver can be placed over a desk or table on which light material, such as paper or currency, is spread. Incidentally the system is of considerable value from a hygienic standpoint, as it assists in the ventilation by continually changing the air in the apartment where the terminals are installed.

The carriers are merely cylinders of sheet brass covered at each end with felt to protect the metal from abrasion in passing around the elbows of the tube. They range from four to six inches in length for the ordinary store service, but do not fit closely against the side of the tube. Enough space is provided to allow the carrier to be borne along by the air current with little or no friction except at the turns, thereby permitting of a much greater speed than if the carrier acted as a piston and was continually in contact with the tubing. The receiving terminals are of two kinds, although both work automatically. The ones used in the cashier's and bookkeeper's department are merely open tubes, which are usually suspended

over a receiving table or desk. An air valve is placed in the receiver at a point three or four feet from its end. This is so adjusted that merely the pressure of the carrier against it opens the valve. The carrier then drops by gravity to the end of the receiver, and is taken out by the cashier's clerk or bookkeeper. As soon as the carrier passes, the valve is shut by a spring, and thus the current is confined. The air is then diverted into a parallel tube connected with the sending terminal, the operation of which has already been described. The return tube to the sales department also terminates in the valve, which is located directly at its mouth. When the carrier is sent back, its impact is sufficient to open this valve, and it drops upon the salesman's table, the valve closing automatically and confining the air current as in the other instances. The system in the cashier's and bookkeeper's department requires some one to take the carriers out, in order that they may be examined as they are received, thus preventing unnecessary delay in making change. As the extent of the service is limited only by the power of the blower plant, some of the pneumatic systems which have been installed in department stores recently constructed are very extensive. Perhaps the largest in the United States is located in Philadelphia. It consists of over 250 stations, each connected with a line varying from 400 to 500 feet in length. A plant of 150 horse power is utilized, and in all nearly 20 miles of tubes are used. The power is sufficient to force the carriers through every line as rapidly as they can be inserted in the tubes.

Carriers of three and four inches in diameter are employed for transmitting papers and small packages in factories and warehouses, where bulkier material is required to be transferred from one portion to the other. The arrangement of the tubes is the same, and the carriers are received and dispatched according to the same plan, the power plant being, of course, correspondingly larger to meet the requirements.

Not only the blower, but the compressed air system is utilized in the long-distance tube service which is employed by the Government in New York and other large cities in connection with the Post Office Department. Thus far, the plants for transmitting mail have been principally used in conveying it between New York and Brooklyn by way of the present Brooklyn Bridge and between the main post office in New York and the Grand Central Station. Here carriers which are 10 inches in diameter and about 3 feet in length are employed. The most extensive installation of this kind, however, is in operation in Boston, extending from the retail shopping district on Harrison Avenue to Back Bay, South End, Roxbury, Dorchester, and other sub-stations. This system conveys carriers which are 10 inches in diameter. The tube is laid underground, and consists of ordinary cast-iron water pipe finished at the joints in order to make a close fit. It is laid like a water conduit, with lead and iron joints, the curves being of 12 feet radius to the center line. The bends were cast in sections, the standard of 90 degrees comprising three 30-degree sections bolted together. The carriers which, as might be imagined, were manufactured especially for the purpose, consist of sheet metal riveted together, but move through the tube on wheels, five of which are placed at each head. The carrier is opened at the side by a hinged door. On account of size and weight, the terminals are of special design. The receiving terminal consists of an air cushion closed at one end by a revolving valve, opened and closed by a cylinder and piston operated by the air from the tube. Ordinarily this valve is closed, but when a carrier enters the receiver, it compresses the air in front of it. This pressure affects a small auxiliary valve. When the carrier is brought nearly to rest, the auxiliary overbalances and moves the controlling valve of the main cylinder. This opens the revolving valve, and allows the carrier to roll out. Just at the end of the receiver two vanes are mounted, so that the pressure of the air behind the carrier tends to move them. This motion is made use of to restore the auxiliary valve to normal position and close the receiver. The carrier is placed in the tube by moving valves connected with an air lock.

The power for this system, which is over ten miles in length, is compressed air, the service requiring about 1,400 cubic feet per minute, the pressure varying from 1¾ pounds to 2 pounds. Before entering the compressors the air passes through a tank filled with calcium chloride, which effectually removes all moisture.

This tank is open to the atmosphere, and the pipe connections are so arranged that the air of the incoming line passes through the tank and returns to the compressor. Only such air has to be dried as is lost through leakage or used for operating the machines. The compressors are duplex belt-driven with 21-inch x 12-inch cylinders. There are two each at the main, South End, and Roxbury stations, and one each at Dorchester and Back Bay. The compressors are driven by 50 horse power, three-phase induction motors of the internal resistance type.

The system has been found to be an excellent substitute for wagons and other methods of delivery, and is largely used by merchants for sending parcels to the residence districts where sub-stations are located. At these they are sorted and distributed to the houses of the customers by teams and messengers. It is found that the average time required to deliver packages from the main station to any portion reached by the service in ten minutes, where from forty-five minutes to an hour would be required by the usual method of delivery.

Train Pipe Leakage.

The increasing use of air brakes in freight service is developing certain difficulties of operation and maintenance that are greatly reducing the efficiency of the brake service possible if certain conditions can be controlled. The principal manifestation of an unsatisfactory state is the large number of instances in which but few of the whole number of brakes in a train are connected. This is a most objectionable practice and just contrary to the ideas that led to the application of brakes to freight trains. The chief causes are few in number and at the head of the list is train pipe leakage.

If this leakage is of any considerable degree the pump is overtaxed, with abnormal wear and tear, and brakes are cut out of service until the pump capacity is sufficient to keep a working pressure. It also interferes with graduated brake applications on level track and is almost fatal to safe working on down grades, for when communication with the main reservoir is cut off, leakage acts in one respect as an engineer's valve in that train pipe pressure is reduced and the brakes are applied, but without manipulation on the part of the engineer. As the leak is out of his control, the application continues until the brakes are fully set, even though only a moderate force is needed or desired. It is therefore evident that train pipe leakage not only limits the number of brakes that can be used but also seriously interferes with the proper and normal actuation of those that are in service, and is one of the principal causes for excessive air pump repairs.

The principal source of leakage is from defective hose-coupling gaskets that have been injured by the practice of pulling the couplings apart when cars are separated, instead of uncoupling them by hand. While the construction of the coupling is such that this can be done without injuring the hose, yet a continuance of the practice destroys the gasket. It appears to be conceded that it is practically impossible to get trainmen to disconnect couplings by hand, and the remedy seems to be the substitution of a coupling that can be pulled apart when cars are uncoupled without in any way affecting its capability for making an air-tight joint.

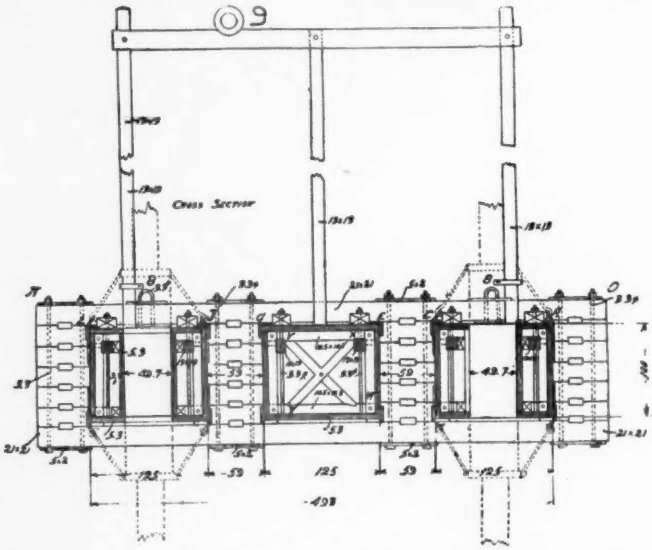
It was to accomplish this object that the Westinghouse automatic coupler was brought out. For this coupler it is also claimed that it facilitates the making up of trains and insures the use of brakes in many cases where now there is a disposition to couple up just enough to meet the requirements of the situation as measured by the ideas of the trainmen. A train partially fitted with air brakes has elements of danger that are to be avoided as far as possible, and it would seem that anything that will automatically tend to assure the operation of all the brakes on the train is in the right direction.

Submarine Drilling.

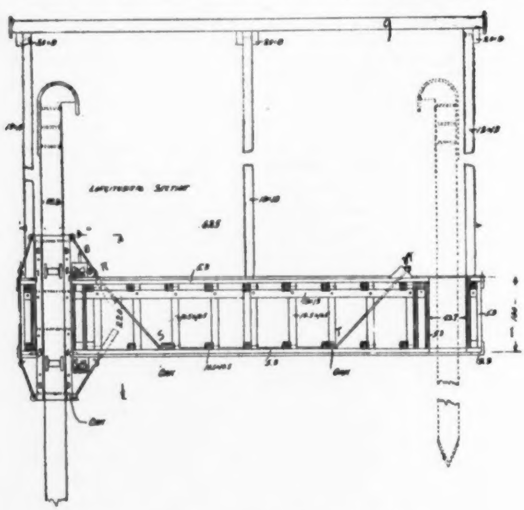
An example of the platform method for submarine drilling is afforded by the accompanying illustrations, which represent an outfit constructed by Mr. Leegaard, Government Harbor Inspector, Christiania, Norway.

The platform consists of three pontoons connected together by beams, braces and bolts; the pontoons themselves being built on frames, plated up with timber and well caulked and trussed in-

side to make them rigid to withstand the shaking produced by the working of the drill. At the ends of the pontoons are enough smaller than the guides to prevent sticking, should swelling occur. The spud guides are of oak, heavily bolted and



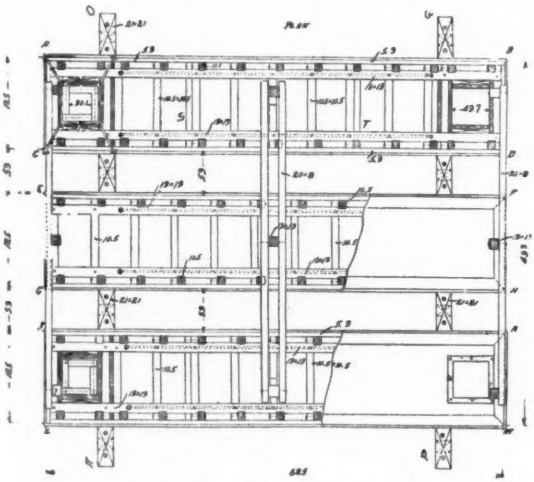
SECTIONAL VIEW, SHOWING COMPOUND BEAMS CONNECTING PONTOONS.



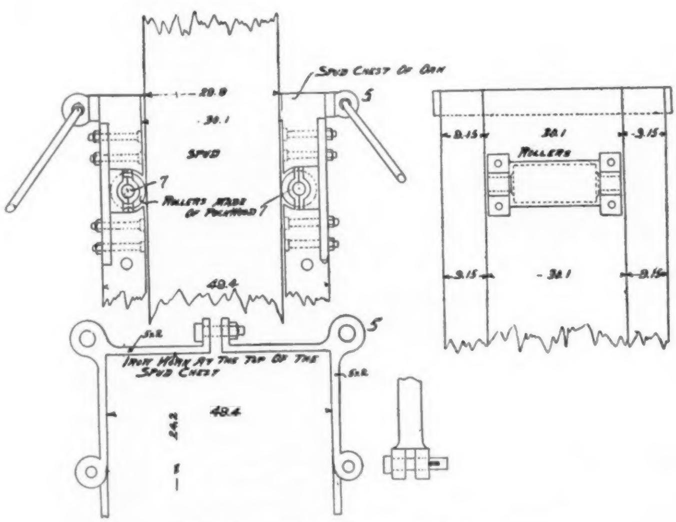
SECTIONAL VIEW OF PONTOONS.

suitable slides or guides for the spuds and water-tight bracing bulkheads. Heavy oak spuds are used and these are made held together with hoops running entirely around. These hoops are arranged for removing, so that the spuds can be taken

out, which is necessary in case where the pontoons are to be transported. The rollers in the guides are placed in the ends differential blocks. In order to lift the spuds, four other differential blocks are used, attached to the framing overhead,



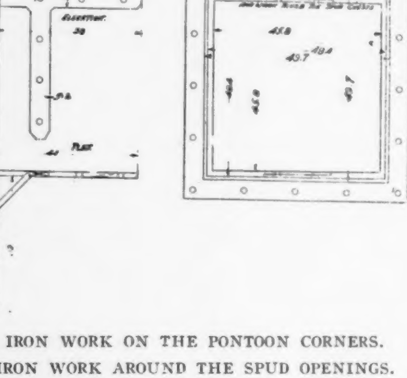
PLAN OF DRILLING PLATFORM.



SECTIONAL VIEW OF SPUD CHESTS.

and fit against the spuds snugly to avoid too much play. The pontoons are suspended on the spuds by means of 8-ton each with a capacity of two tons. To lift the drill steels and handle the drill an ordinary tackle is used attached to the

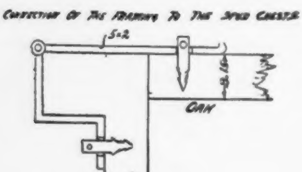
superstructure. The spuds are fitted with shackles, whereby the pontoons are suspended at the right height. This relieves the differential blocks of the load and throws the full weight on the spuds. The submarine tube and the drill steels are easily lowered through the opening between the pontoon, or the drills may be mounted on beams projecting over the side of the partition so that the equipment can cover quite an area at one setting. The entire weight of pontoon with drill, drill steels and crew is 22 tons.



IRON WORK ON THE PONTOON CORNERS.
IRON WORK AROUND THE SPUD OPENINGS.

The consort scow contains a boiler and a good steam winch, which is used to lift the broken rock and to handle the platform when it is floating. These platforms have proved very strong, and one of them has been working for two years without alteration.

By means of the Ingersoll-Sergeant drills and the arrangement just described, Mr. Leegaard has made excavations in very hard granite rock at the rate of 11 meters per day. In rotton rock and clay



the drill has been found to work very satisfactorily.

For blasting in clay and rotten rock the cartridges are enclosed in tin, with a wooden point, and a wooden rod is used to shove them down into the holes.

In speaking of this plant, Mr. Leegaard says: "Submarine rock drilling by steam is decidedly cheaper than by hand, not only as regards the running depth of a hole, but drills more deeply by cubic meter."

Michigan Mine Adopts New Plan for Air Compressor.*

The system of air compression to be installed at the Victoria mine in Ontonagon county, Mich., almost passes belief in its economy and simplicity. The water power of the canal is to be converted directly into compressed air power without the agency of machinery, and practically without expense for maintenance or labor after the plant is installed.

The system is not an experimental one, but has been adopted by the management of the Victoria after a careful and exhaustive inspection of several plants of the kind now in commission. There are five such plants operating in America and several in Germany. One is at Magog, Que., which has been in successful operation for six years, without expenditure for repairs or maintenance and without variation in the pressure of the air. This has a capacity of 150 horse-power. A second is in Ainesworth, B. C., which has been in operation three years and generates 500 horse-power.

In Norwich, Conn., is a plant of this kind generating 1,500 horse-power. All the industries of the place receive their power from the plant, including the street car lines. In some instances at Norwich the compressed air power is converted into electricity, while in others it is used direct. Another plant at Peterborough, Ont., is to be used in connection with one of the locks on the Trent Valley canal, under the immediate supervision of the provincial government. Another hydraulic air compressor is located in the Cascade range in the State of Washington. A similar plant in Germany has demonstrated a constant efficiency of 90 per cent. of the theoretical horse-power of the

* By Arthur L. Carnahan for *The Mining World.*

falling water. The largest one ever constructed is now planned for Montreal, where it is expected to generate 50,000 horse-power. The average efficiency of the hydraulic air compressor plants now in commission ranges from 75 to 90 per cent. of the water power expended in compressing the air.

The principle upon which the system is to be installed at the Victoria mine operates is that falling water entrains a large amount of air in bubbles, making the water foam. This water and air is then confined by falling through a pipe for a considerable distance, and the air in the foamy bubbles will separate itself from the water, being lighter. This separation cannot take place, however, while the water is confined in the pipe and under velocity. It is not until the water empties from the lower end of the pipe into a larger chamber that the air ceases to be retained in bubbles. But by that time it is trapped under a head of water represented by the height of the pipe, which in the case of the Victoria will be 370 feet. It is also at the bottom of a shaft 300 feet deep, which is filled with water. It will be seen, therefore, that the air is under a heavy pressure. It is calculated that the Victoria plant will maintain a pressure of 140 pounds of air to the square inch.

The installation of the system at the Victoria will necessitate the sinking of a 300-foot shaft into which the pipe for the falling water will extend and in the bottom of which the compressed air will be trapped. The trap will be a large chamber, into the top of which the pipe will discharge and from another point in the top of which a pipe will extend upward as an outlet for the compressed air. This outlet pipe will lead to a receiver on surface and the air will be piped thence to the different points of utilization.

The chamber at the bottom of the shaft will have an open space between its lower rim and the floor of the shaft, and the water, after having settled and given up its atmospheric contents, will flow out around the bottom of the chamber and thence to the top of the shaft, surrounding the pipe in which the descending water and air is contained, discharging finally into a spillway which will conduct it back to the river. Thus the air will be under a double head of water, one in the pipe leading downward for 370 feet and the other in the shaft leading upward for 300 feet.

The water will flow from the west branch of the Ontonagon river at the recently constructed dam and thence through the canal now being built for a distance of about 4,000 feet. Such portion of it as is to be used will pass, at the end of the canal, into a hopper with a hood covering. Down through this hood will pass 500 small tubes. The falling water will create a partial vacuum in the hopper and the air will be drawn down through the tubes of the hood and entrained in the water, filling it with bubbles.

It will flow immediately into the vertical pipe, which will be built in three increasing stages. The top portion of the pipe will be four feet in diameter, the middle portion six feet in diameter, and the bottom portion eight in diameter. The air is thus trapped and cannot escape, but must be carried to the bottom of the pipe.

From the top end of the pipe, it is a descent of 75 feet before the collar of the shaft is reached. Then it is 300 feet to the bottom of the shaft. It is estimated that between 25,000 and 29,000 cubic feet of water will be utilized per minute.

The principle of utilizing falling water for the compression of air was first applied in ancient times. It has been modernized by a number of inventors, each making improvements on his predecessors or branching out into new lines. One of the most successful of these is C. H. Taylor, of Montreal, who is the inventor of the method to be used at the Victoria. Mr. Taylor is expected to visit the Victoria shortly to look over the conditions there. The sinking of the shaft for the plant has already been commenced and it is expected to have the equipment installed by next spring.

Probably one of the oldest applications of the use of water power to the wants of man was a form of hydaulic air compressor which entrained air on the same principle that is now being applied. This was the well-known water bellows or trompe of the Catalan forges. The water was led to a hollow bamboo pole, set almost vertical, and entrained air with it in its downward passage. The lower end of the bamboo pole was introduced into a bag made of the skin of some animal, the air being allowed to escape from the

water into the upper part of the bag, whence it was led by pipes to the forges. The water then passed from the lower edge of the bag.

An Englishman named Siemens invented an apparatus for the non-mechanical compression and exhaustion of air, somewhat on the principle of a steam injector. But it was confined principally to the production of a vacuum. It was used to operate the pneumatic dispatch tubes in London and for blast purposes in Siemens' furnaces and sugar works. Among other inventors who have worked on the direct compression of air by flowing water, through the medium of both vacuum and entrainment, were W. L. Horne, M. Romilly, J. P. Frizell, A. Baloche, A. Frahnass, Thomas Arthur and C. H. Taylor, the latter being engaged as consulting engineer for the Victoria plant.

Mr. Taylor was the first to introduce the plan of dividing the air inlets into a multiplicity of smaller apertures evenly distributed over the area of the water inlet. As stated before, the Victoria will have 500 of these air inlets. This insures the largest possible proportion of air being taken down with the water. He also introduced the idea of enlarging the bottom of the inflow pipe, which serves to diminish the velocity of the water and facilitate the separation of the air. A deflector plate set just below the water level in the compression chamber breaks the fall of the water from the down-flow pipe.

In the Magog plant, which is the oldest in America, the head of water before entering the down-flow pipe is 22 feet; the pipe is 44 inches in diameter and extends down through a ten-foot shaft which is 128 feet deep. At the bottom of the shaft is the compression chamber, 17 feet in diameter and ten feet high, the shaft being enlarged at the bottom to accommodate it.

A series of very careful experiments was conducted at the Magog plant a few years ago. It was then demonstrated that with a head of 19½ feet of water, using 4,292 cubic feet of water per minute, the equivalent of 1,148 cubic feet of free air per minute was recovered, which would represent 248 cubic feet of air per minute compressed to 53.3 pounds' pressure. This shows that out of one gross water horse-power of 158.1, 111.7 horse-power of effective work in compressing air was accomplished, which is an efficiency of 71 per cent.

This compressed air was then used in an old Corliss engine, without changing the valve gear in any way from what it was adjusted for steam, and 81 horse-power was recovered, showing a total efficiency of work, recovered from the falling water, of 51.2 per cent. When the compressed air was pre-heated to 276 degrees before being used in the engine, 111 horse-power was recovered. The heating required 115 pounds of coke per hour, equal to about 23 horse-power. The efficiency, therefore, recovered from the falling water and the fuel consumed was about 61½ per cent. It is calculated from other experiments, that had the compressed air been heated to 300 degrees the total efficiency secured would have been about 87½ per cent.

The plant in the Cascade range of mountains in Washington is unique in that it did not require the sinking of a shaft. The apparatus is constructed against the vertical wall of the canyon in the rugged mountain district in which it is built. The diameter of the down-flow or compressor pipe is three feet. The diameter of the up-flow or water discharge pipe is 4 feet 9½ inches. The total height of the apparatus is 260 feet. The capacity of the plant is based on the utilization of 2,000 miners' inches, equal to a flow of 53.2 cubic feet per second. It gives 200 horse-power of air at a pressure of 85 pounds to the square inch. The head of water is 45 feet.

In the application of the compressed air at the Victoria mine, it is planned to actuate all machinery at the mine and mill through this medium. This will include the hoisting engines and stamp head, and it is calculated that there will be scarcely any changes necessary in the valve gears or other mechanism.

Pneumatic Haulage Plants for Mines.

With the introduction of machine methods of mining in the collieries of this country the little mule, who has for so many years done his work so faithfully, is gradually being supplanted by locomotives operated generally by either compressed air or electricity. While there has been more or less contention regarding the relative advantages of the two kinds of power for haulage, electricity and

compressed air, the compressed air motors are steadily gaining ground owing to their freedom from danger, their economy and simplicity. Of the compressed air motors which are in practical use, none have proved more successful than those manufactured by the H. K. Porter Co. These are being used regularly in a number of mines to-day and, where properly equipped with a suitable plant, are very successful.

The essential features of a compressed air haulage plant include a locomotive of suitable weight and power and constructed to carry sufficient compressed air to meet all of the requirements; a charging station or stationary reservoir which may be a pipe-line where long or diverging runs exist, or one or more storage tanks when the runs are short; an air compressor of suitable design; and power for operating the compressor.

The general machinery of the air locomotive is quite similar to that of the steam locomotive, save that the weight is usually greater, the bearings larger and other details of construction stronger. The main differences are that instead of the boiler with its accessories for developing power the air locomotive is equipped with one or more main storage tanks which are charged with compressed air at high pressure, a regulator or automatic stop valve and an auxiliary low pressure reservoir in which the air is carried at a uniform working pressure for distribution to the cylinders. The cubic capacity and the pressure of air of the main storage tanks are determined by the amount of stored energy which the length of run, grades, weight of train and estimated resistances demand, the limitations as to height and width admissible also being taken into consideration.

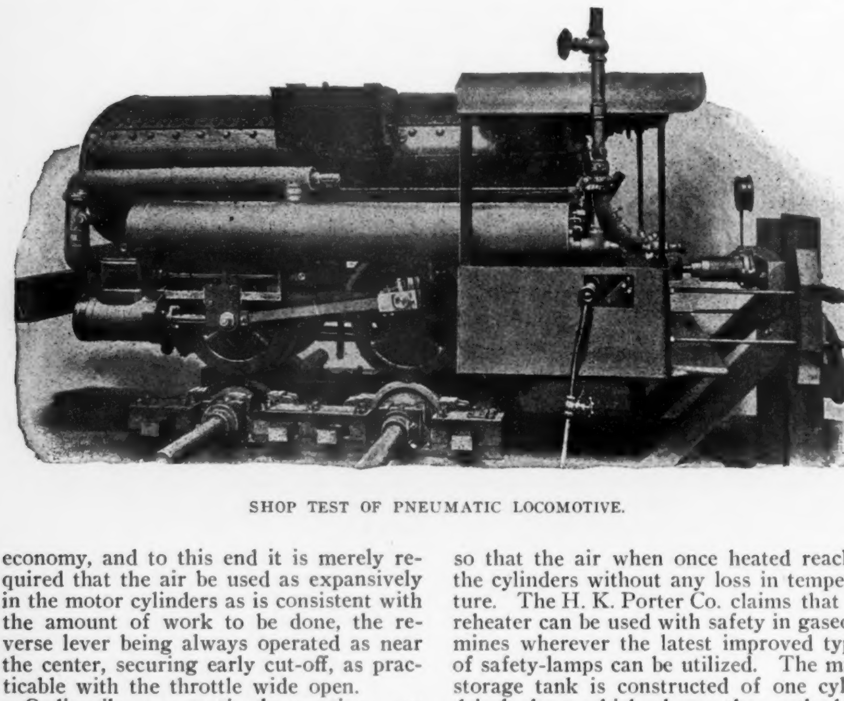
The tanks, for all pressures up to 800 and 1,000 lbs., are made of flanged steel plates of high tensile strength. The thickness of the plates is proportioned to the pressure to be carried and to the diameter of the tanks in such ratio as to allow a large margin on the side of safety. Relief valves are adjusted to make it impossible to carry a higher pressure than is required. Of course, all dangers incident to the operations of the steam locomotive boiler, such as excess pressure, burnt crown sheets, or collapse of fire boxes or flues from low water, are entirely eliminated in the operation of the air locomotive, as the boiler and its accessories, which are the chief items of repair on a steam engine, are replaced by air tanks which are practically indestructible. The number of wearing parts being reduced to a minimum, the cost of repairs and maintenance is much less with air than with a steam locomotive. For easy grades, short hauls and light loads the single storage air tank of moderate dimensions and designed for a pressure as low as from 400 to 500 lbs., may be sufficient. In some cases even lower pressures may be used, but there is more economy in the use of a reasonably high pressure. For more severe requirements a larger cubic capacity usually in the shape of two or more storage tanks designed for a working pressure of from 800 to 900 pounds per sq. in. may be required. In rare instances it has been deemed advisable to use seamless steel tubes from 8″ to 10″ in diameter and carrying a pressure as high as 1,500 to 2,500 lbs. In cases of extremely long haul with heavy tonnage, where the limitations as to width and height are very severe, it has been found desirable to equip the motor with a separate air tender which can be uncoupled when so desired. This arrangement has been introduced with much success in a number of instances and with considerable economy in the installation of pipe line or receivers for storing up air between trips.

In operation the air locomotive is comparatively simple. The high pressure air in the main storage tank passes through the regulator and automatic stop valve to the low pressure or auxiliary reservoir. The regulating valve is intended to maintain whatever pressure may be found most economical for operating the motor. 140 lbs. per sq. in. is usually found generally satisfactory, although this pressure can be increased by adjustment of the stop valve to 150 to 160 lbs., when the work is particularly heavy, or when, in case of emergency such as getting derailed cars on the track, some excess of power is required. This regulation of air between the high pressure and low pressure reservoirs is designed to be at all times uniform, the air being admitted as fast as it is needed and at the required pressure. When the throttle is closed and no air is being used, the stop valve is arranged to close automatically preventing any leakage from the high pressure tank

to the low pressure reservoir. It is also possible to operate the stop valve by hand as a positive stop valve should the motor be standing still for a considerable length of time, as over night or during days that the plant was not in operation. The duties of the operator are reduced to a minimum, as the pressure of the pipe line or receiver system is already established when the plant is designed or installed, thus insuring the motor its full complement of air in the storage tanks, and as the air is distributed to the auxiliary reservoir without any manipulation necessary by the operator. It is only essential that the low pressure air be used with the greatest economy, and to this end it is merely required that the air be used as expansively in the motor cylinders as is consistent with the amount of work to be done, the reverse lever being always operated as near the center, securing early cut-off, as practicable with the throttle wide open.

Ordinarily pneumatic locomotives are operated by using the air cold as drawn from storage tanks, but there are cases where it is deemed wise and economical to reheat the air before it enters the auxiliary reservoir on its way to the cylinders. The additional efficiency gained by this reheating varies from 35 to 50 per cent., depending, of course, on the efficiency of the reheating appliance used. For operating in gold or silver mines or for any conditions of service where the haul may be very long or where extremely narrow tunnels necessarily cut down a locomotive tank capacity and further where the cost of fuel is very high, it may seem desirable to use some system of reheating, of which there are several now being used with success.

One of the accompanying illustrations shows a shop test of a Porter air locomotive having 5" x 10" cylinders, designed for 18" gauge of track and equipped with a hot water reheater. All the reheating attachments and auxiliary reservoir are carefully covered with insulating materials, so that the air when once heated reaches the cylinders without any loss in temperature. The H. K. Porter Co. claims that its reheater can be used with safety in gaseous mines wherever the latest improved types of safety-lamps can be utilized. The main storage tank is constructed of one cylindrical sheet which shows the method of riveting. Arrangements for sanding the rails, etc., are shown in the picture. The locomotive rests on friction rollers, which are provided with a pony brake and the tractive force developed is measured by a dynamometer.



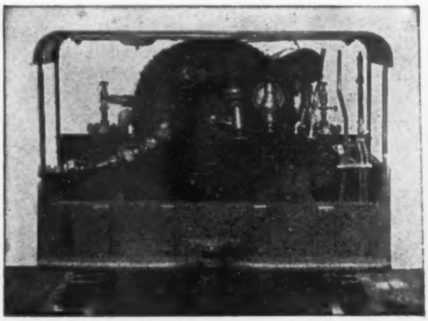
SHOP TEST OF PNEUMATIC LOCOMOTIVE.

There are two methods of charging locomotives, direct and by reservoir. Charging direct is generally considered

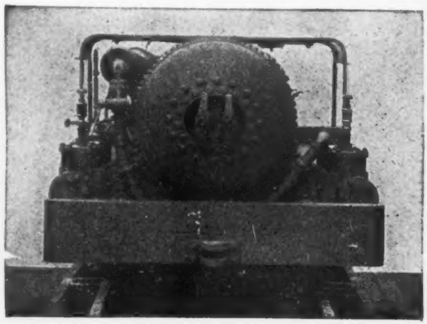
wasteful because it involves a locomotive and compressor of practically double capacity. For very light work, however, where the trips are made only at considerable intervals, direct charging may be at least doubled by the addition of a stationary charging reservoir. The stationary reservoir is the most satisfactory and economical method in the majority of cases. Such a reservoir may consist of a pipe line or one or more storage tanks similar in construction to the locomotive storage tank except they are usually constructed with somewhat higher pressure.

By the receiver system the compressor is kept in nearly continuous operation at very nearly uniform speed, and with the proper system of governing requires little or no attention on the part of the engineer or operator. In early installations, even when the runs were long, the practice was to use large air receivers with very little pipe, the motor generally taking its charge direct from the receivers at the end of its round trip, but in a number of plants recently installed there has been a change in favor of a pipe line of a certain cubic capacity, the size and length of pipe depending largely on what point in the mine it was necessary to reach in order to arrange charging stations so that the motor could always receive conveniently the amount of air required for doing its work. After a pipe line is once installed it ordinarily requires no extensions. If additional locomotives are purchased the only essential feature is to have compressor capacity sufficient to charge the original pipe line to its full complement of air a greater number of times during the day in order that the additional motors when taking air should always have sufficient air to charge the tanks to the usual pressure. The general character of the service required and the local conditions determine the choice between the pipe line and a tank system of reservoir storage. In industrial establishments where no lines of pipes are desirable, one or two charging stations located near the storage tanks and connected thereto with pipe of small diameter have been used with success. Then there are certain conditions in mine services where the installation of the reservoir storage would be of temporary character on account of the likelihood of the plant only being operated for a few years, it then being necessary to take it up and reinstall it at some other point. In such a case it is believed that the most satisfactory course would be the introduction of the storage tanks and the location of one or two charging stations connected to the tank by 2 or 3 inch pipes. In cases where the pipe line extends the entire distance of the main haul, it has often been found advisable to locate a charging station at each end of the line. By charging at each end instead of once for the entire round trip, tanks of less cubic capacity and carrying lower pressures would be required on the motor and a corresponding reduction can be made in pressures and pipe line capacities. Air leakage is less dangerous than electric leakage, but with the marked advancement that has been made in the laying of pipe lines for high pressure work the element of leakage has been virtually eliminated.

In pipe installation it has hardly ever



REAR VIEW OF SINGLE-TANK AIR LOCOMOTIVE.



FRONT VIEW OF SINGLE-TANK AIR LOCOMOTIVE.

been found necessary to use any pipe above 6 inches in diameter; 5 inches has been the size very generally utilized and cases have frequently occurred where pipe as small as 2 or 3 inches has been found available. In pipe lines a mile or more in length the differences in pressure at the two ends has been hardly appreciable. The fact that while the motor is doing its work the pipe line is receiving a full complement of air from the compressor insures that any loss from friction does not work against the motor in any way inasmuch as the capacity of the pipe is such as to give the motor its full pressure of air when necessary, the cubic capacity of the pipe line and the pressure of the air in the same being such as to equalize almost instantly at the required pressure in the motor tanks.

For high duty work with pressures ranging from 500 to 1,000 lbs., three or four stage compressors are being generally used in recently installed plants. They take the air from the atmosphere and compress to the required storage pressure in the main pipe line of receivers. In some classes of service, especially mines where locomotives are not used continuously and where more air at the mine pressure could be utilized if it were available, the compressor may be so arranged as to furnish at a moment's notice a large quantity of air at a less pressure and with little or no loss of efficiency at a very slight increase at cost. The manufacturers, however, are advising against the use of a high duty compressor for operating a locomotive and then reducing this air compressor to the pressure required in the general mine system for running coal machines and other work. This, of course, would save the installment of a second pipe line for the low pressure system, but the loss of power would be enormous, as more cubic feet of free air would be required for the mining machines than for the locomotives, and the cost of compressing large amounts of air to high pressures, say from 700 to 900 lbs., and then reducing it again to 80 lbs. would be wasteful and uneconomical in the extreme.

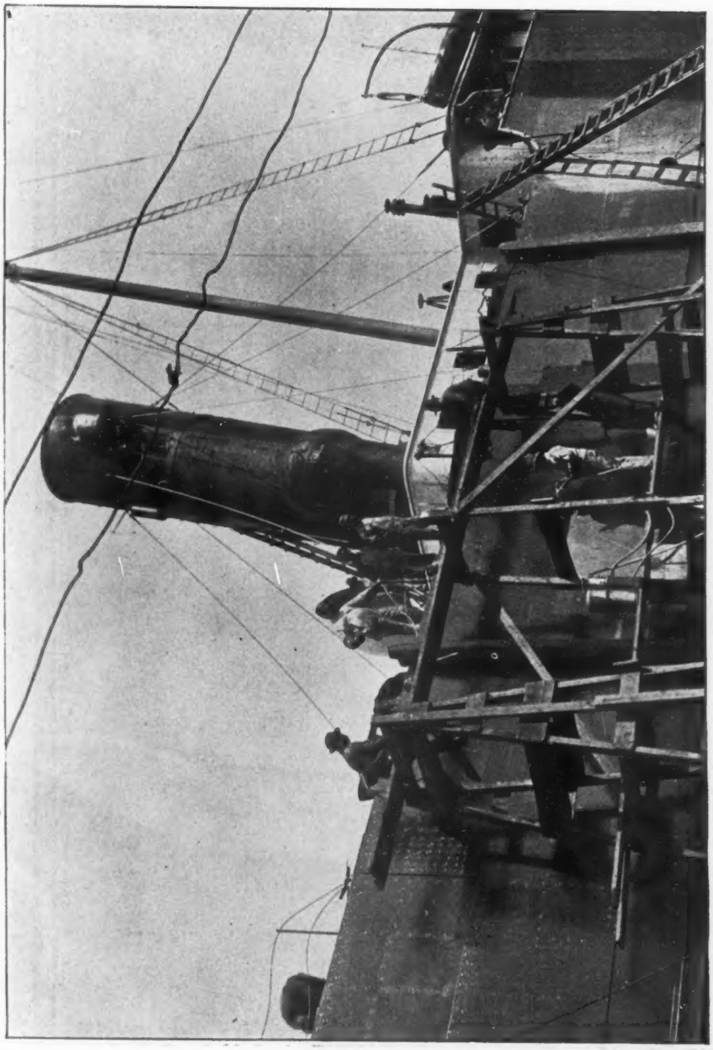
In some mines that have already installed low pressure compressor systems for running coal cutters, etc., and in cases where this compressor system represents a surplus of power, there has been installed a small two-stage compressor as a locomotive charger, taking the air from the mine system instead of from the atmosphere. This, of course, materially reduces the cost of the locomotive charging compressor, but it has its dangers, except in very large mines where the supply of air to the mine is greatly in excess to actual needs. The trouble will come about in this way. Assuming that a small two-stage compressor is designed to take air at 80 lbs. from the mine system and compresses it to 800 lbs., as long as the locomotive charger is getting its air at 80 lbs. there will be no difficulty, but if in the mine system the pressure is allowed to decline, as sometimes happens, the locomotive compressor will not get air at more than 35 or 40 lbs. pressure and in this event overheating appears inevitable.

To sum it all up, it might be said that the advantages of compressed air haulage are its simplicity, safety, handiness, economy and reliability, a combination of attributes which no other system of mine haulage possesses.

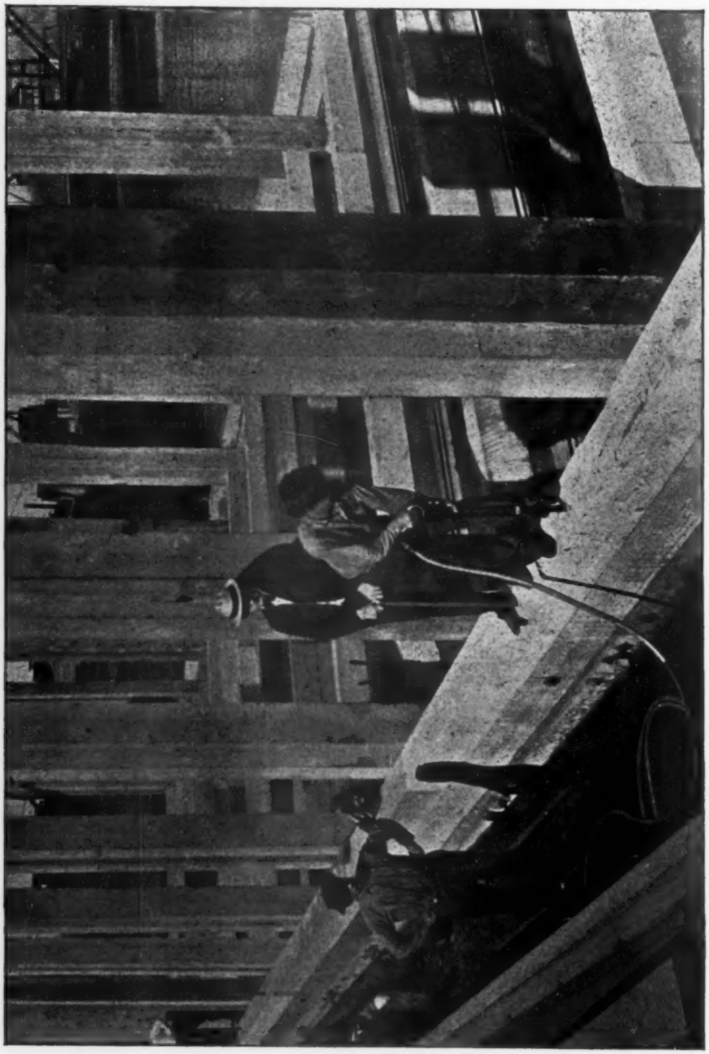
Compressed Air for Marine Work.

Among the various uses of compressed air which have been prominently brought forward within the last few years, is that of painting, the air being used to spray the paint wherever desired. Such a pneumatic appliance has been used with much success on the interior and exterior of large buildings. Along the same lines these pneumatic painting machines have been utilized in ship work. Now that the large steamers demand such frequent coats of paint, a rapid and effectual way of painting is of great advantage. The illustration on the opposite page, which was secured through the courtesy of The Cleveland Pneumatic Tool Co., shows one of its pneumatic painting machines at work on the side of a large steamer.

Another use of compressed air has been featured by the same company. The illustration on page 2475 shows a special riveting hammer used for driving drift bolts in crib work. The same pneumatic hammer can be used in the construction of docks and other marine work, and has, it is claimed, met with great success in that field.



PAINTING A SHIP WITH PNEUMATIC SPRAY.

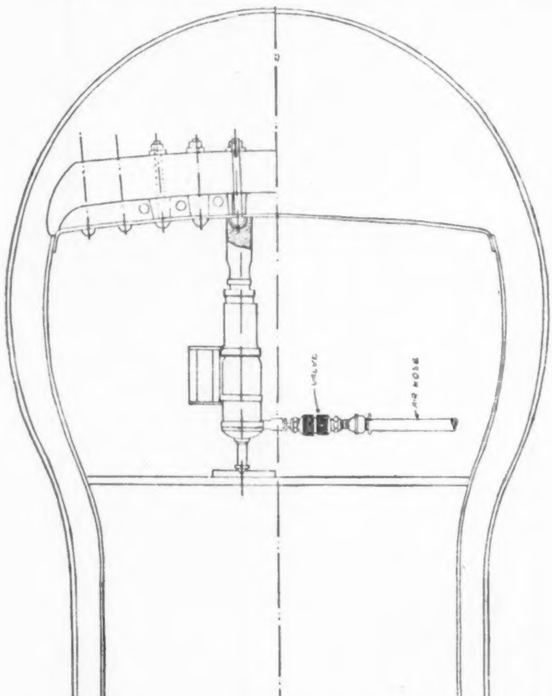


PNEUMATIC RIVETING HAMMER FOR CRIB-WORK.

New Applications for Pneumatic Tools.

Among the new applications for pneumatic tools are two for the Jam Riveter, made by the Chicago Pneumatic Tool Co. It is now being used with success in cleaning crown sheets and expanding boiler tubes on locomotives. The accompanying illustrations show the method of doing this work.

In cleaning the crown sheets, a 2-inch plank is placed across the fire-box to support the riveter. It is arranged with cupped dies to fit over the rivet head or head of the stay bolt, the dies striking the sheet around the rivet head. When air is admitted to the machine the pressure holds the dies against the sheet while the riveter strikes a succession of heavy, rapid blows. The work is done without removing the crown bars or radial stays, and the results obtained, it is claimed, have been highly satisfactory not only in expediting the work, but also from the fact that the work is well done. This cleaning is usually done when the engine is in the shop for general repairs and when the tubes are removed.

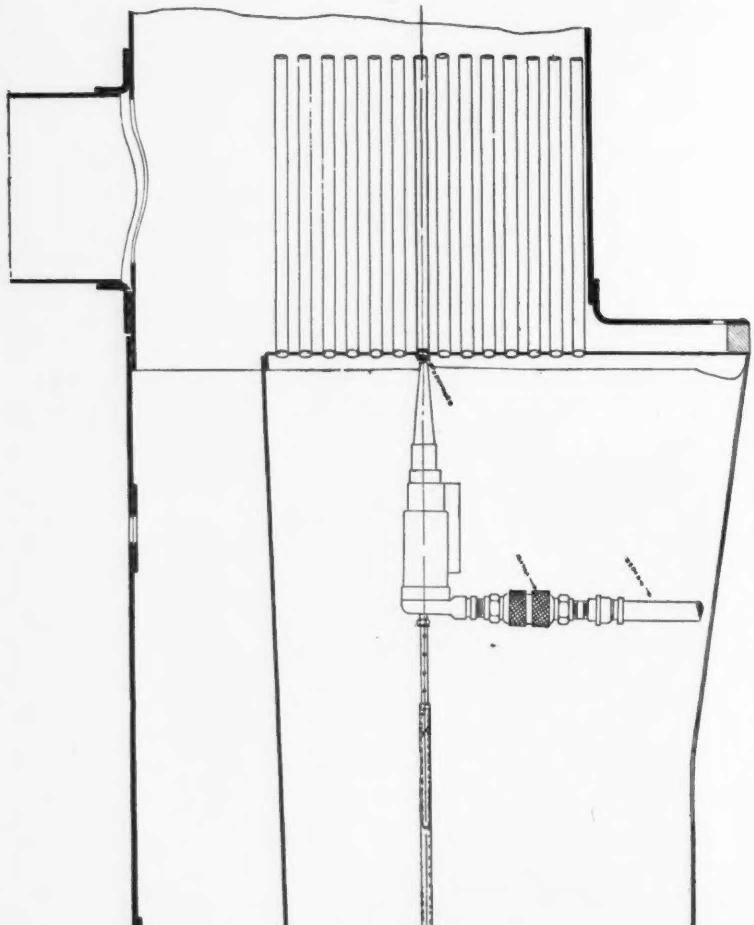


CLEANING CROWN SHEETS WITH JAM RIVETER.

This method has been in use by the New York Central and Hudson River R. R. for about 18 months. At two of that company's shops in 1900, they were removing by the old method an average of 15 sets of crown bars per month. During 1901, they began using this method and showed a considerable decrease in the number of locomotives from which the crown bars were removed. In 1902, it was found necessary to remove the crown bars from only four locomotives.

The Jam Riveter has also been utilized with success in expanding tubes with a

sectional tube expander. Tube expanding has been done to some extent with long-stroke riveting hammers, but the Jam Riveter is said to be more successful on account of its greater power. In performing this work the Jam Rtveter is suspended by a counter balance leaving practically no weight for the workmen to hold up.



EXPANDING BOILER TUBES WITH JAM RIVETER.

The Ruth Flue Machine.

Inventors of labor-saving devices have found exceptional opportunities in the manufacture and repair of locomotives. One of the latest machines designed to assist in this work is the Ruth Flue Machine. It is driven by an engine using air or steam and is especially designed for cutting out and replacing boiler tubes. It can be used on any style of boiler, but is particularly adapted for locomotive use. It can also be utilized for drilling, capping and cylinder boring.

The machine is portable and, it is claimed, can be used for all purposes where practical portable power is necessary. By placing a pulley on the horizontal shaft of the machine, with the aid of the belt it can be used to drive any shop tool.

The accompanying cut of the machine shows a conical cylinder into which works a piston, upon the head of which piston is a swiveling platform upon which is mounted a modern engine. Upon the crank-shaft of the engine will be found a pinion which works with a gear on the horizontal spindle by means of which the shaft is rotated, the lateral movement of the shaft being accomplished by a hand-wheel and screw. The entire machine is mounted on an iron truck.

It is claimed that a flue expanded by this machine will give more mileage than a flue expanded by hand for the reason it is expanded gradually, the expander rotating continually from start to finish. The old hand method, it is said, is more apt to distort the holes in the flue sheets into all kinds of shapes. This flue machine has been placed on the market by Robert J. Emory & Co., 4652 Lawrence St., Newark, N. J., whose New York sales agent is W. W. Worthington & Co., of 114-118 Liberty St.

RUTH FLUE MACHINE.

Air Compression by Water Power: The Installation at the Belmont Gold Mine.*

This water power is situated in the township of Belmont, county of Peterborough, Ontario, about three miles in a north-west direction from the Belmont Gold Mine.

On the outlet of Deer Lake there are falls and rapids which give a head of 75 feet in a distance of 1,600 feet. Still further down the river there is another drop of 25 feet, all being on the property of The Belmont Gold Mine, Limited, Cordova, Ontario.

Deer Lake is about four miles long by a mile wide and holds a splendid reserve of water for the dry season. The lake is fed by a chain of smaller ones which extend north about 100 miles. This makes an ideal situation for a power plant.

After the power was acquired the question was electricity or compressed air. The generation and transmission of electricity would have cost less at the power house and to the mine, but it would have been necessary to have put up a motor driven air compressor at the mine to supply drills with air, and motors at hoists and engines. This would have brought the first cost of the electric installation to a higher figure than one large air compressor plant, besides the attendance, etc., at the motor driven compressor at the mine would swell the working costs. By installing one large air compressor at water-power and carrying the compressed air in pipes to the mine, branching it off in all directions to the shafts and mill, it would not be necessary to make any alterations on any of the engines or hoists. All that was then required to be done was to shut off steam and turn on air to the engines, hoists and pumps without any loss of time when air was turned on at power plant. This left the steam plant, boilers, etc., with all their connections as a good reserve power in the event of anything going wrong with the air power. In this arrangement, it permitted the using of machinery which was comparatively new, being only two or three years old.

One important point was the getting in of an air compressor plant large enough to do the mine work for a long time to come. As the underground requirements for air increased there could be more power developed at the falls by electricity to work the surface machinery. Then would be the time for considering the motor driven machinery, as by that time the proper size of machinery for handling the quantity of ore would be better understood.

The outlet of Deer Lake was formerly by two channels, 300 feet apart, through a fine grained diorite rock. The south channel was closed with a concrete and cement masonry dam, 85 feet long, 9 feet wide at top and 16 feet at base and 15 deep at the greatest part. On top of the dam are small piers 18 feet apart for bridging with timbers for a passage across. Underneath this and over the top of the dam the surplus water goes when stop logs are in at the slide way on the north dam. The north dam is 75 feet long with a 25 foot slide for the passage of logs. In front of the north side is a forebay with a 30 foot rack. This is where the water is taken out of the lake for the power, through a 7 foot square opening in the dam with a gate on the side next to the lake. The gate is worked by means of a rack and pinion wheels wrought by worm shaft and wheel. The water intake to the flume is reduced from 7 feet square to cylindrical by means of steel work with flanges and fasteners for the wooden staves of flume pipe. On top of the dam, behind the gate and going down into the water entrance of the flume pipe is a man or air hole. Without such the shutting down of gate at the dam, allowing the water to pass through the wheel, would create a vacuum in the flume, causing a tendency to collapse or disturbance to staves, resulting in much trouble and annoyance through leaks when water was turned on again.

The flume pipe is 1,550 feet long, 6 feet internal diameter and made of 2½ inch pine staves, 6¼ inches wide, radial edges, butt joints with saw drafts cut 2 inches into both ends into which was placed a steel plate ¼ of an inch wider than the stave to embed into the staves on both sides. No two joints come together, but at irregular intervals, the staves being cut in 12, 14, 16 and 18 foot lengths and clamped with 2000 3-16 x 2 inch steel bands and fastened with grip fasteners. The pipe is carried on 12 inch square timbers circled out to take the outside circle of the flume, and these bearer timbers are placed 8 feet apart, centre to centre. The

*By D. G. Kerr, C. and M. E., Deloro, Ont., for *The Canadian Mining Review*.

steel bands are spaced 3 inches apart at the lower end and 24 inches at the top. There are two curves in the flume of 20° each. The $6\frac{1}{4}$ inch staves were too wide and rigid to be sprung into place on the top of the flume, so 1-3 of the top staves going around the curves were made $3\frac{1}{8}$ inches wide.

The bed of the flume was cut through ridges of rock for the first 900 feet from the dam, 3,960 cubic yards of rock excavation being done by steam drill in the winter season. At the lower end there is 217 cubic yards of stone piers to carry the flume over a low piece of ground before arriving at the power-house, and inside of the power-house a steel tube takes the place of wooden staves.

The cost of the wooden flume, made of pine, came out at $3.00 per foot, while the estimated price for this length of steel (flume only) was $15.00 per foot. The power-house building lies north and south and the part which contains the compressor is 40 x 50 feet. South of this is a cooler room 43 x 16 feet, and north of the main part is the water wheel part, 64 x 35 feet. The water-wheel is a double 50 inch bronze Leffel wheel with double discharge and running at 210 revolutions has a capacity of 800 horse-power, taking 7,500 cubic feet of water per minute. The water gates of the wheel are made of cast steel, and the casing of ½ inch steel plates with cast-iron heads. The water-wheel is carried on a steel shaft which extends at one end for the transmission of the power by means of a rope pulley, 5 inches in diameter and 6 feet 4 inches wide across the face, with 30 grooves for 30 $1\frac{3}{4}$ inch cotton ropes. On the top of the wheel casing is a dome 2 feet in diameter by 10 feet high with valve, and just above this valve are two pipes, 12 inches in diameter, having spring valves and leading into draught tubes. This is an arrangement for the relief of undue pressures from water ram, such as might be caused by the water-wheel gates on a long flume through which water is traveling at a certain rate, being shut down quickly. This arrangement takes the place of a stand pipe; costs less and there is no danger of its freezing, as it is all under cover. On wheel case is a gauge showing water pressure and head in feet, and on draught tube is a vacuum gauge giving the vacuum in inches. The water-wheel, wheel casing, etc., were furnished by The Wm. Hamilton Mfg. Co., Peterboro.

Underneath the wheel is the tail sump, and from that the tail race going into the river. This was excavated out of solid rock to a depth of 20 feet and has cement masonry walls with steel beams and bolts with which the wheel casing is held in place. This tail sump is carried west underneath wheel to take the water from another wheel of 350 horse-power, for which there is provision for water made on the steel part of flume by means of a tee piece. When this other wheel is at work the water velocity through the six-foot flume will be brought up to about 10 feet per second. The intention is to develop this 350 horse-power with a direct driven dynamo, alternating current.

The air compressor which is driven by these 30 $1\frac{3}{4}$ inch cotton ropes from pulley on water-wheel shaft is built on the compound horizontal principle; high pressure cylinder, 30 inches diameter; low pressure cylinders, 48 inches diameter and with a 4 foot stroke. The cylinders are water jacketed, provided with improved accessible inlet valves and fitted with metallic packing on the piston rods. It is rope driven by means of a 20 foot pulley, 6 feet 4 inches across face, weighing 60,500 lbs. and built in sections on massive concrete and cement foundations, 14 inches high. Running at 65 revolutions, or a piston speed of 520 feet per minute, it will have a capacity of 6,500 cubic feet of free air per minute.

The low pressure air cylinder intake is connected together by branch pipe from the 3 foot pipe to the atmosphere outside. This 3 foot pipe lies horizontal on the top of the low pressure air cylinder, one end going to the south and the other to the west end of the building. The air is compressed in the low pressure cylinder to 30 lbs. pressure and is then discharged through a 14 inch pipe to the intercooler, and from there, after being cooled, to the high pressure cylinder, from which after being compressed to a pressure of 100 lbs. per square inch, it passes into the after-cooler. The inter-cooler and after-cooler are filled with brass tubes through which flows cold water and the compressed air passes and repasses over the outside of the tubes and is cooled down to within 10 degrees of the temperature of the water used. In this cooling process

there is considerable moisture deposited, as it is only by cooling the air to the lowest temperature that a high extraction of the moisture can be had.

The air leaves the after-cooler through a 12 inch pipe or ordinary oil well casing, having fine screwed couplings and tested to 600 lbs. pressure. Half a mile out from the compressor is an air receiver to collect any moisture which may have passed the after-cooler. This moisture is drawn off every day.

The 12 inch pipe line from the compressor to the mine is 15,000 feet long. At the end of this pipe line at the mine is another air receiver to collect any moisture which may have been carried into the pipe line. The only time of the year that any moisture is expected to be carried this length, is when spring sets in and the heat of the sun frees any moisture from the inside of the pipe. This will be very little, as the air receiver near the compressor is in a low swamp, and the air line leaving it for the mine has a gradual raise of 50 feet into the 2,000 feet, thus draining moisture back into the receiver. The pipe line has 18 expansion joints and is mostly all buried in sand to prevent expansion and contraction.

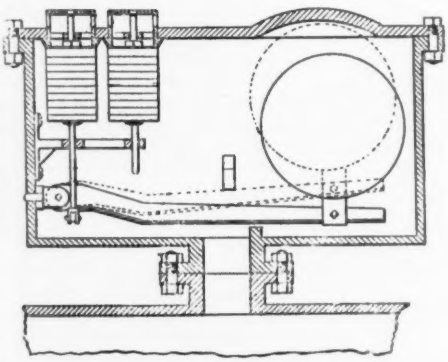
The foregoing is only a slight description of the plant. As it was only started running in August, 1902, and has not been run up to its full capacity yet, the loss in pressure due to friction in transmission cannot very well be arrived at. The loss at present is less than 1 lb., but using the full quantity of air the loss is expected to be 3½ lbs. What I would like to have completed, but found impossible in the short time that the plant has been running, is a complete comparison between summer and winter of the temperature at which the air is taken into the compressor, the amount of moisture extracted and the temperature of water used in coolers.

During the past winter there was only one shut down owing to freezing. This was caused by the moisture in the receiver half a mile out from the compressor being allowed to freeze through not being drained off every day. The ice formed in a honeycomb form until it interfered with the air pressure at the mine, reducing same to 65 lbs., while there was 105 lbs. at the compressor. Shut down and found the receiver full of this honeycomb ice. After taking out same, started up again and covered up the receiver with a shed, banked so as to keep off the intense frosts and permitting the moisture to be drained off.

At the mine I have had no trouble with freezing up except with a Corliss engine and a 14 inch duplex pump. I find that engines with slide valves give no trouble, due to non-expansion of air inside of cylinder.

A New Air Valve.

A few years ago a 72-inch steel pipe storm water sewer was laid in Jersey City, discharging under pressure. This pipe was practically level for 2,100 feet, with its invert about 5 feet below mean low water; it received the drainage from the "Heights" partly through a 40-inch cast-iron pipe 1,500 feet long and partly through a 48-inch cast-iron pipe 1,600 feet long. The speedy and certain removal of air from these mains during storms occurring when the mouth of the sewer would be sealed by the tide was absolutely essential.



TUTTLE'S AIR VALVE

For this purpose Mr. Arthur S. Tuttle, M. Am. Soc. C. E., in 1900, designed an air valve which has given such good satisfaction that he decided to place it upon the market. It is automatic in action both for discharging air or other gases collecting at the high points of pipes carrying water or other liquids and for admitting air to the pipe in the event of the rapid removal of the liquid tending to form a partial vacuum.

The apparatus consists essentially of a closed chamber to be connected to the

pipe by a flanged nozzle, containing one or more buoyant poppet valves on vertical spindles and a float attached to a lever. Over each poppet valve is a small turret with openings to the atmosphere. The cover is flange-bolted to the chamber so as to be readily removable for inspection, cleaning or repairs. The action of the valve is very simple. Assuming first the case of a pipe being filled, the chamber contains only air and the poppet valves rest upon the bracket seats shown so as to leave the air passages to the atmosphere open. When the water nearly fills the chamber, the buoyancy of each valve causes it to close promptly. The chamber will remain sealed so long as there is liquid enough to keep the valves seated. If, however, air or gas accumulates in the chamber, the water will gradually be forced from it, and the buoyant weight at the end of the lever will finally drop, under the action of gravity, and cause the lever to bear upon a pin extending from the side of the valve spindle, thus opening the valve and permitting the escape of the air. If the relative proportions of the valve have been properly made to suit the pressure in the pipe, equilibrium can only be restored by carrying the poppet valve down and holding it open until disengaged by the rising of the float arm, as the water rises in the chamber. The travel of the arm and float are limited by a stop, as indicated. The spindle of the valve is held in a vertical position by guides so that it will always come to an even seating. The float being wholly contained within the air-chamber is caused to rise and fall solely by reason of its buoyancy and weight without regard to the pressure within the chamber. The several parts are so constructed and arranged that the buoyant weight has a very limited movement and only operates to open the buoyant valve after the air-chamber has become approximately full of air. As the air escapes from the chamber and the water rises in the same, the buoyant weight will be given its maximum elevation by flotation long before the water rises sufficiently in the air-chamber to close the buoyant valves by flotation. A considerable period is thus permitted to elapse between successive operations of the apparatus, as the valve is not opened until the chamber is approximately full of air and is not closed until the chamber is approximately full of water.

It is claimed that this new air valve is very positive and reliable in action and does not permit the escape of water, although promptly discharging any accumulated air or admitting air so promptly as to prevent collapse in the event of a sudden emptying of the pipe caused by breakage or otherwise. The importance of these properties and the convenience of the wholly automatic action of this valve will be recognized by those who have had experience with air valves. This valve is being placed upon the market by the Eddy Valve Company, of Waterford, N. Y.—*Engineering Record.*

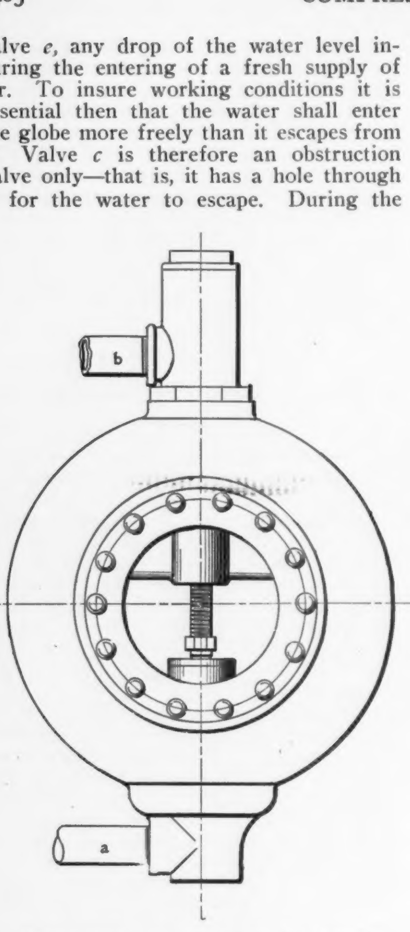
An Automatic Air Chamber Charging Device.

A year or more ago there was quite a discussion in the *American Machinist* on the subject of automatic air chamber charging devices, and several such, made up from pipe fittings, were shown by correspondents.

The illustration on the next page is a more matured design for this purpose which has been applied to several large pumping engines and with very satisfactory results by the Nordberg Manufacturing Company, of Milwaukee.

The main globe casting, which is of 13 inches interior diameter, is located near the water end of the engine and is connected at *a* with one end of one of the pump cylinders and at *b* with the air space in the air chamber. The connection at *a* being with a pump cylinder, the interior of the globe is subject to alternate pressure and suction. During the suction stroke the globe is filled with air by the valve *d*, and during the pressure stroke this air is expelled through the valve *e* and the pipe *b* to the air chamber. The valve *c* is introduced to control the ingress and egress of the water. On the one hand air must not enter so freely as to more than fill the globe and then escape to the pump cylinder, and on the other the globe must be so nearly full of water that the rise during the pressure stroke will expel the air. With free egress of the water it might easily escape in such volume that, opposed by the compressed air above it, it should not rise to a point where the air would be expelled. On the contrary, there is no danger of having too much water in the globe, as the return of the water from pipe *b* is prevented by the

valve c, any drop of the water level insuring the entering of a fresh supply of air. To insure working conditions it is essential then that the water shall enter the globe more freely than it escapes from it. Valve c is therefore an obstruction valve only—that is, it has a hole through it for the water to escape. During the



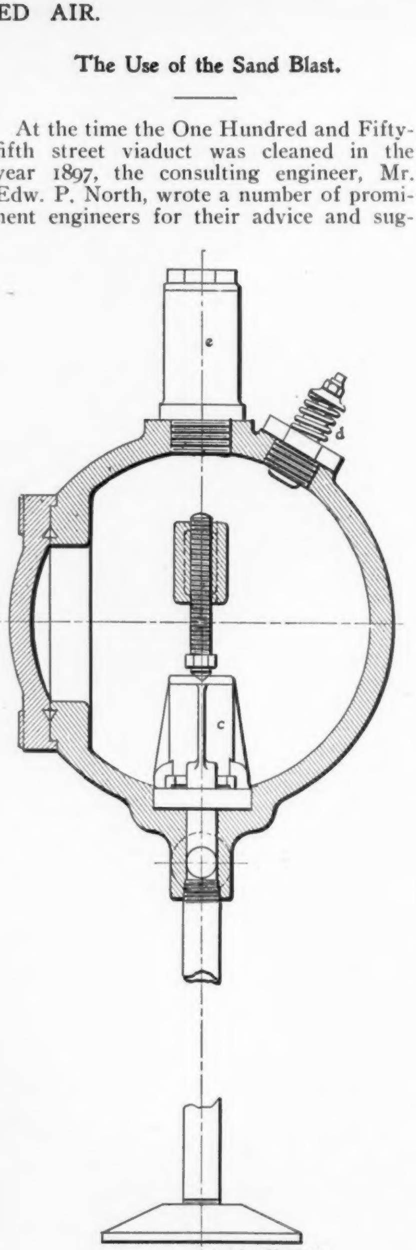
AUTOMATIC AIR CHAMBER CHARGING DEVICE.*

pressure stroke this valve opens freely and the water enters and expels the air, but during the suction stroke the water can only escape through the hole and the flow outward being more restricted than that inward, it is made certain that the volume of water escaping from the globe will not be in excess of that which will again completely fill it and expel the air on the succeeding pressure stroke.—*American Machinist.*

*** We are indebted to the Nordberg Mfg. Co. for the use of this cut.**

The Use of the Sand Blast.

At the time the One Hundred and Fifty-fifth street viaduct was cleaned in the year 1897, the consulting engineer, Mr. Edw. P. North, wrote a number of prominent engineers for their advice and sug-



gestion, as to the best method to be employed, and we have taken the liberty of

re-copying a few of the replies received, which we are enabled to do through the courtesy of Edgar T. Ward & Sons, Boston, who have published a small pamphlet comprising these letters.

" Relative to painting of iron-work, I would say that I examined the sand blast cleaning at One Hundred and Fifty-fifth street with great interest. Twenty years ago I went to Philadelphia and had some zinc sheets cleaned by the sand blast at the works of General Tilghman, and also inspected the steam blast then in use for cutting stone; I was therefore sure that the action of the blast would be very effective for cleaning the scale from iron-work, and I found the improved appliances at One Hundred and Fifty-fifth street were acting with a degree of success that even exceeded my anticipations. From my experience with painting iron-work in this city I have become convinced that it is nearly impossible to have structural iron-work properly cleaned and painted on the clean iron surface before erecting. This should not be so. But at present the shops do not seem to be properly equipped for cleaning iron-work and removing scale and for painting before the rusting has commenced. In the case of a viaduct recently erected in this city all possible care was taken to have the clean metal well painted before it left the shop. A reasonable degree of success was obtained with the main structure, but the railing from the Belmont Iron Works was sent here with a coat of paint applied to a rusted surface, and this railing is now, after little over a year's exposure, a mass of rust, while the rest of the structure is in very good condition. I am convinced that money spent in painting a surface not previously cleaned from rust in a thorough manner is wasted, and I regard your experiments as being valuable in the highest degree. I considered expenditure made for the purpose of getting a perfectly clean surface on which to paint to be eminently wise, and if success is not found to follow your painting on this clean surface it would be a reasonable deduction that iron-work is unsuitable for use in structural work exposed to the action of the elements.

I anticipate that the result of your experiments will be highly successful; if these experiments prove costly, it is not more than would be expected from pioneer attempts. I hope that before many years constructors of iron-work will awake to the importance of proper cleaning and painting in the shops, and for the cleaning before painting I cannot think of any process that will equal the sand blast in efficiency." Horace Andrews, M. Am. Soc. C. E., City Engineer, Albany, N. Y.

"As to the judiciousness of the method pursued cleaning the viaduct at One Hundred and Fifty-fifth street by means of sand blast received, I crave your permission to reply at some length.

The appropriations for the maintenance of bridges in Baltimore for some years past having been very small, no painting has been done, consequently quite a number of the bridges are sadly in need of paint, one particularly, Argyle Avenue Bridge, over the Pennsylvania Railroad, concerning which we spoke to you when we visited the One Hundred and Ffty-fifth street viaduct. This bridge is situated between the portals of two tunnels, and so close to one portal that the smoke coming from the tunnel frequently envelopes the bridge; also, all locomotives of trains going west which stop at Pennsylvania Avenue Station, stand immediately under this bridge, and since the engine-men fire up, preparatory to the trip through the next tunnel, the escaping gases and steam have played havoc with all members of the structure, which has not been painted since erection, twenty years ago. The wooden floor being in very bad condition and having to be renewed, we removed it entirely before the cleaning of the trusses began, so that access could be obtained to all members of the structure. The scale on this bridge was over ¼ inch thick, and the iron and steel were pitted to a depth of 1-32 inch to 1-16 inch; the cross-section of web of floor-beams was reduced fully 1-16 inch, and the other members to as great an extent. One thing which was especially noted was the fact that the erection numbers painted on the floor-beams were distinct, and when the paint was scraped away the iron was perfectly clean. Unfortunately, it was impossible to discover the kind of paint used, but it was presumably white lead. Chipping hammers, steel scrapers and brushes were used to clean this bridge, the labor for which cost about 5 cents per square foot, but I do not consider the result satisfac-

tory. We had much difficulty to have the laborers clean the iron thoroughly, for they were too prone to slight the work so as to seem to accomplish much rather than to obtain the best results, which fact militates greatly against cleaning by scraping, etc.

Whilst this work was in progress, I visited the One Hundred and Fifty-fifth street viaduct, where the sand blast was in operation, and returned feeling thoroughly dissatisfied with our efforts, and convinced that the sand blast should be used for cleaning structures, so favored the purchase of a plant.

So little care is really taken to properly clean iron in the shops before the first coat of paint is applied, that frequently corrosion begins before the paint is applied, producing the results with which bridge engineers are so familiar; and since there are so many inferior paints used, it is not strange that they peel off and crack, and allow corrosion rathen than prevent it.

To preserve a structure and obtain the full amount of use from it, it is necessary that it be kept free from rust by some method, and too much care cannot be taken for its preservation; it is not sufficient, as the layman ordinarily considers, to erect a structure and then leave it alone; but frequent painting is absolutely necessary, how frequent depends upon the conditions to which the structure is subjected and the preservative used. In the past, hammers, scrapers, brushes, etc., have been used for cleaning structures, but results have proved unsatisfactory; and I cannot too heartily recommend the use of sand blast on structural iron before the first coat of paint is applied in the shops, and upon structures which are to be cleaned preparatory to painting." Layton F. Smith, Assistant Engineer in Charge of Bridges, Baltimore, Md.

"With reference to the use of the sand blast in cleaning the metal-work under your charge, I would state that my experience and observation in the line of paint on metal structures have led me to the following conclusions: Where a structure has become corroded it is essential that all rust be thoroughly removed before the application of new paint. Scrapers and steel brushes do this but imperfectly, and the irregularities, and frequent inaccessible surfaces caused by structural connections, render it practically impossible by such methods, without an expenditure of time and labor which would ordinarily be considered prohibitory. There is no question but that the portion of the One Hundred and Fifty-fifth street viaduct over the Manhattan Elevated Railroad tracks had reached a condition requiring prompt and thorough treatment. Cleaning by the usual methods would have been very costly, and at the best unsatisfactory. The cleaning done by the sand blast as far as the work had progressed at the date of my inspection, was admirable and complete, leaving the naked metal surface entirely clear, as could not be done by the processes usually applied.

There can be no question as to the comparative results of the sand blast and the usual appliances. It is to be expected that experience in the appliance of the sand blast will result in lessening the cost of application. Doubtless the cost of the usual hand manipulation of scraper, brush and chisel to produce any approach to the thoroughness of the sand blast would now cost far more.

In conclusion I would state that for the foregoing reasons I believe the use of the sand blast was judicious, and in accordance with an appreciation of the importance of dealing thoroughly with the question of metal coatings, which has only, within a recent period, begun to receive the attention its importance demands." Charles M. Mills, Assistant Engineer in Charge of Gray's Ferry Bridge, Philadelphia, Pa.

Receiver Pressure in Air Compressors.

A correspondent writes *Power* as follows:

The question frequently comes up as to why an air compressor will pump up a receiver pressure greater than the boiler pressure. This, of course, refers to the steam-driven machine with the usual balance wheel or wheels. I have known this to happen on locomotives, under certain conditions, and in this case it is the well-known direct-acting Westinghouse air pump.

It does look curious to some of us, but it really is in accordance with natural laws. Take, for example, the ordinary machine driven by a slide-valve engine

with a throttling governor. Its valve may cut off somewhere between one-half and three-quarter stroke, or a little later. The balance wheels are rather substantial and their momentum comes in good play. Keeping in mind the law of compressible gases and the general appearance of a compressor indicator card (air end), I think it can be easily demonstrated. Suppose 105 pounds gage to be the receiver pressure and the boiler pressure to be 100 pounds. For simplicity's sake, I am using round numbers and ignoring the effects of the heat resultant from the compression of the air; but possible leaks at inlet valves, piston and piston rod may in a measure offset this. Now, beginning at one dead center, follow the action of both ends through a revolution. The air cylinder is filled with air at atmospheric pressure and the inlet valves are closed. The steam cylinder is taking steam at a sufficient pressure to maintain the necessary speed, depending on the position of governor valve of course. Supposing the valve to cut off at three-quarters stroke and expansion to begin before the air discharge valves open, it can be plainly seen that the engine easily overcomes internal friction of the entire machine, together with the resistance of the air to be compressed with an admission pressure considerably below boiler pressure.

The pressure on engine piston is continually decreasing as expansion goes on; at the same time air pressure is continually increasing until after discharge valves open. But remember the stored-up energy in our balance wheels; and right now (when the engine is lacking power and most needs it) is when it gets in its work. Let us also remember that our crank-pin is traveling continually faster in relation to the piston and its load, so that as it nears the dead center the flywheel energy has greater advantage, or, we might say, greater leverage on the piston and load, and passes over. On the return stroke the operation is simply reversed in the steam and air cylinders, respectively.

Of course there is a limit to all things, and how much the receiver pressure can be made to exceed the boiler pressure will depend on the speed, the size of the machine compared with the demand for air, and especially on the relative diameters of the steam and air cylinders. It is plain that the larger the air piston (after it exceeds the diameter of steam piston, which it sometimes does) the less is the possibility of this action.

Other things being equal, it appears to me that the later in the stroke the discharge valves open, the higher can the receiver pressure be pumped with a given steam pressure. Now, the higher the receiver pressure is carried the later the valves open. Any leaking of inlet valves, piston or piston rod has the same effect. So will a restricted inlet pipe, as we have really a less volume to start with.

I have in mind an article by Mr. F. Riddell, some issues back, in which he mentions the experiences of a Western visitor who made a wooden cover for the 6-inch inlet pipe, with a 1½-inch hole in center, fitted with a shutter for regulating according to conditions.

Wouldn't heavier balance wheels help out sometimes, provided of course that the compressor is not too large and can be kept at a reasonable speed?

In regard to the Westinghouse air-brake pump, it doesn't often cut this caper, and I will not take time to explain how it can come about; but when it does happen, it has the advantage of taking steam practically full stroke and has the momentum (and weight on down stroke) of pistons, etc., to assist, as would also leaky inlet valves or clogged air strainer.

The above is my theory on the question, which I have seen brought up several times in different papers. I have not gone into deep mathematics in regard to compression and effects of heat on pressure, etc., nor have I attempted to show the exact point of discharge valve opening, but used the plain example to illustrate my ideas. W. A. G.

Hanna Portable Pneumatic Screen Shaker.

The Hanna pneumatic screen shaker is the simplest possible arrangement of a valveless piston working in a cylinder, the piston directly attached to a holder arranged to hold the ordinary 18-inch, outside diameter, circular *foundry riddle*. The whole mounted either on a tripod (Fig. 1) or on a frame (Fig. 2), to be held by sockets fastened to posts or building walls. There is practically only one moving part, and no joints working under reversing strains.

Through a one-half inch mesh riddle the machine will shake all the sand that two men will care to shovel. Through one-fourth mesh all that one man should shovel; other sizes in proportion.

FIG. 1.

The machine will use about 12 cubic feet of free air per minute, and is designed to work at 80 pounds gauge pressure. The cost of compressing 1,000 cubic feet of free air to 80 pounds gauge pressure depends

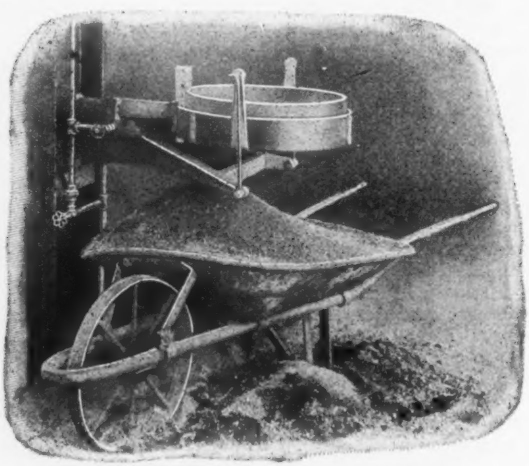


FIG. 2.

upon the compressor used, and upon the arrangements for handling and cooling the air before, during and after compression. The minimum may be stated at about 1½ cents, and the maximum may run up without any extraordinary circumstances to 6 cents, or 4 3-10 cents for 720 feet, the amount that the screen shaker might use in one hour. There is no reason for expecting such an expense, but it might be estimated that there would be a cost of 2 7-10 cents per hour for repairs on machine, compressor, hose, couplings, pipe line, riddles, etc., and the total operating expense for one hour would amount to 15 cents for one man and 7 cents for air and repairs; total, 22 cents. Should the question arise as to what there is to show

for this expenditure, the answer would be: "As much sand as this one man would have riddled by hand, or have wheeled to stationary machine in five hours." Cost of wages alone, 75 cents; saving, 53 cents.

It is emphatically a portable machine (see Fig. 3), and was designed with this as the guiding idea. The machine being easily moved, you can screen your sand right where you want to use it.

FIG. 3.

The tripod machine weighs 100 pounds; one man handles it. The Post machine weighs 50 pounds; a boy can handle this. There are other so-called portable machines on the market, weighing from 500 pounds to a half ton, mounted on four-wheel trucks, or to be placed by crane.

Miners' Phthisis.

It was a cause of satisfaction when it was publicly announced that the Transvaal authorities had appointed a commission to inquire into and report upon the health of miners and the conditions of labor in the mines; also that the Chamber of Mines had offered prizes for practical suggestions as to the best means of obviating the dangers to miners caused by the inhalation of the fine dust produced by rock drills.

The Chemical, Metallurgical & Mining Society of South Africa very properly set aside a few of its meetings to discuss miners' phthisis. A series of interesting talks was the result.

Reviewing the various opinions given, the *Mining Journal*, of London, England, says: "It must be admitted that it is difficult in discussing a malady induced under circumstances where there is probably more than one cause in operation to assign to each its proper share. All impure atmospheres reduce the vital resistance of the individual who is obliged to breathe them for a lengthened period. Even small quantities of CO and CO_2 are harmful, but as a rule the effects of these gases are transitory. They do not leave any structural changes behind in the respiratory organs. There is nothing in the lung upon which they exercise an injurious influence. The gases enter into physico-chemical relations with the constituents of the blood, and in acute poisoning they induce death by asphyxia. Oxygen, in a word, is not conveyed to the tissues. It is difficult, therefore, to understand how a transitory condition with no associated circulatory or structural alteration of the pulmonary tissues can give rise to miners' phthisis. The only gas that is apparently capable of causing changes in the lungs is nitric peroxide, but it is so virulent in its action that it induces acute pulmonary inflammation, which is apt to cause death in two or three days. The fact that Rand miners' phthisis is more rapidly fatal than that of the coal miner—a circumstance explained by the particles of grit in silicosis being harder and more angular than those of coal in anthracosis—and that a rapidly developing form of phthisis occurs similarly in men who follow dusty occupations above ground are facts that point to dust and not gas being the principal agent in causing the disease. How far in addition miners' phthisis on the Rand may not be tubercular is a point upon which the discussion has thrown little or no light. This part of the inquiry is still under consideration. Before any united action can be taken there must be a closer agreement of opinion as to the causation of the malady."

Notes.

Among the latest catalogs and price lists is a substantial little volume issued by the Lunkenheimer Co. of Cincinnati, O., manufacturers of valves, injectors, oil cups and steam specialties.

A new publication just issued by the W. J. Clark Co. of Salem, O., is pamphlet No. 24, which illustrates and describes some of the important products of these manufacturers of metal specialties.

Galland & Henning Co., of Milwaukee, has just contracted for the installation of 20 pneumatic drums at a cost of $1,900 each. They are to be supplied by The Conrad Schreier Co., Sheboygan, Wis.

The Empire State-Idaho Mining and Developing Co. has purchased motors for driving concentrating mill machinery and the compressed air plant in the mines at Wardner, Idaho. The electric transmission line is 90 miles long.

One of the largest turntables on the Pennsylvania Railroad System has been put in operation at Bradford, Pa. It is eighty feet long, is operated by compressed air and the largest engines can be easily turned on it. For months the company had to turn their large engines on the "Y."

A company has been organized at Delphi, Ind., to manufacture the Harris compressed air pump, which is being successfully operated in the oil field near here. It is claimed that a well producing ten barrels per day by usual methods, can be made to run in excess of 100 barrels by means of this pump.

In the *Iron and Coal Trade Review*, Mr. E. Kilburn Scott, M. I. E. E., A. M. I. C. E., writes on electric winding engines and describes in the course of his paper a compressed air apparatus for controlling a very large winding engine when the effort required to work the main levers becomes too great.

Mr. Ben Johnson, superintendent of machinery of the Mexican Central Railroad, recently presented a paper before the Railroad Club of Mexico in which he described his attempts to utilize the exhaust from air pumps on locomotives in raising the temperature of the feed water. He claimed that a slight economy resulted.

The Long Arm System Company of Cleveland, manufacturer of the Long Arm electrically operated hatchway for war vessels, has received orders from the Government for hatchways for the battleship "Louisiana" and for the cruisers "Maryland" and "West Virginia," now building by the Newport News Shipbuilding & Dry Dock Company.

Pneumatic cushions and mattresses are not new, but the chief trouble with them has been that they bulge into hillocks and hollows. A. A. Young claims to have hit upon a stay that will hold the air mattress in place and mattresses made with them are now being boomed by the Pneumatic Mattress and Cushion Company, 35 Broadway, New York City.

In view of the increased number of explosions of late on the Baku fields, Russia, the Russian Imperial Technical Society has decided on the recommendation of Mr. A. I. Mancho, a member of that society, to make a number of tests of the gas in various wells by means of the Shaw Gas Tester, which has already been described in COMPRESSED AIR.

The Eastern Vacuum Cleaning Co., Ltd., was registered in England, June 8th, with a capital of £40,000, its object being to acquire interests in patents, licenses, concessions and the like relative to the production, treatment, storage, application, distribution and use of air either rarified or compressed and to carry on a business as carpet and general cleaners.

Ten months ago Gillott coal-cutting machines of the disc type were introduced into the Mynheer splint seam, 2¾ in. thick, at the Dundonald Colliery, Fifeshire—compressed air being used as motive power. In the interim the output has risen from 50 to 300 tons a day. It is stated that a face of 160 yards is holed comfortably in six hours.

A competition was held at the Deutsche Seewarte, Hamburg, on April 1, 1903, for the best contrivance for measuring wind pressure. The competition was open to foreigners, and prizes of $1,250, $750 and $500 were awarded. An additional prize of $750 was offered to the contrivance which would be judged the best after a certain time for trial.

One of the latest of auxiliary appliances for automobiles is an air brake. A small air pump worked by a cam on one of the axles forces the air into a steel compression tank. The pump is arranged to work automatically, ceasing action when the pressure rises above eighty pounds, and beginning when it falls below forty. The compressed air is also used for blowing a whistle and for inflating the tires.

The offer by the empire of Austria-Hungary of a prize of $45,000 for a canal lift works to be built on the Danube and Oder River Canal, furnishes an excellent opportunity for American mechanical engineers familiar with the latest advances in structural steel and machinery work. American mechanical engineers are rated at their full value in that country, where already a number have received consideration for professional services.

Another saving in time is being made possible by the Schenectady (N. Y.) Railway Co., which has placed an air compressor in the basement of the building where the waiting-room of the company is located. Heretofore it has been necessary to send many of the cars equipped with air brakes to the car barns after each trip to have the supply of compressed air replenished. This afforded occasion for considerable delay which is now eliminated.

Berlin, for instance, has a pneumatic tube system superior to any quick delivery system of New York. By it telegrams, letters and postal cards can be sent from one part of the city to another more quickly than by telegraph, at a cost of 6 cents a card, or 7½ cents per letter. If you pay 12 cents, you can have a prepaid answer. This post is called the rohr, or tube, post. Its offices are distiguished by a red lamp, and are to be found in all parts of Berlin.

Inventors of compressed air appliances and other machinery will be more or less interested in a new organization which was formed November of last year, called the Inventors' and Designors' International Protective Association. Its object is to protect the inventors who may join it from any infringement of their patents and to eventually secure more stringent patent laws. The home office of the association is located in the *Times* Building, St. Louis, Mo.

In a circular recently issued by the Russian Customs Department, it was announced that appliances for the use of firemen, consisting of specially made masks with apparatus for the storage of compressed air, or for the purpose of pumping air under the masks while the firemen are at work, are to be dutiable on importation into Russia hereafter. India rubber or other hose through which the air may be conducted under the masks is to pay duty according to the material from which it is made.

The Compressed Air Company, of New York, which has met with many reverses since its organization, is to be merged with a prominent railway equipment company. The capital stock of the consolidated concern will be $6,800,000. Compressed Air stockholders are to get one share of the stock of the consolidated company for two shares of Compressed Air. They are also assessed $3 a share. Alexander C. Soper and Newell C. Knight, of Chicago, are on the directorate of the Compressed Air Company.

The practice of placing a shut-off valve on the main line leading from an air compressor to the receiver, usually situated outside the building, is one which should be discontinued, though fortunately, not in general use. A valve so located may have its sphere of usefulness, but it is difficult to discover just what it is. It is doubtful if a valve placed in the position indicated would pay for its cost and installation. A valve beyond the receiver is recommended, and it can often be employed to advantage.

A new water supply system for the Wisconsin University buildings and the Capitol at Madison, Wis., will be installed this summer. The appropriation of the

Legislature for this purpose four years ago, amounting to $16,000, was found insufficient to build a suitable water tower, and since the Legislature just adjourned refused to increase the appropriation, Acting Dean Turneaure, of the College of Engineering, who has the matter in charge, has decided to install the compressed air system. The present system is totally inadequate.

In the new Schenectady shops of the American Locomotive Co., compressed air is to be utilized to operate small pneumatic riveting and caulking hammers in the boiler shop and the chipping hammers and moulding hammers in the foundry. There are two air compressors, an Ingersoll-Sergeant with a 12½ x 14 inch cylinder, which is belted to the jack shaft, and a Corliss cross compound two-stage compressor built by the Laidlaw-Dun-Gordon Co. with 30 and 18 inch air cylinder and 18 and 30 inch steam cylinders and a 36 inch stroke. The air is to be used at 90 lbs. pressure.

In all the Baldwin-Westinghouse electric locomotives built for heavy haulage work the manufacturers are now recommending a complete air brake equipment. If the service is high speed the air compressor employed may be either motor or axle driven. If slow speed, only the motor driven type is declared serviceable. The Westinghouse Air Brake Company is manufacturing three standard sizes of these motor driven air compressors, which is said to be self-operating, noiseless, dust and water proof. Their capacities run from 11.8 to 29 cu. ft. of free air per minute.

The action of an air compressor is such that the resistance offered by the air that is being compressed is increased from the commencement of the stroke to the point at which the required pressure is reached, and the object and advantage of the fly-wheel is to equalize what would otherwise be an irregular working of the engine. The delivery of compressed air is intermittent, whilst the demand for compressed air is continuous. The receiver enables the maintenance of a uniform pressure notwithstanding the short operation of each stroke occupied in the delivery of compressed air at the required pressure.

The mechanical department of the Pennsylvania Railroad is in the "market" for better and quicker methods for cleaning steel cars with compressed air. It is an unusual thing for the Pennsylvania to go outside and especially to competing lines for information of any kind. The Pittsburg & Lake Erie, however, some time ago installed what is considered one of the best devices for cleaning steel cars. Compressed air is used. The Pennsylvania railroad heard of this, and recently sent Messrs. Gray and Nicoll, of Altoona, to investigate the machines. They were taken in hand by L. H. Turner, superintendent of motive power of the Lake Erie.

In the manufacture of soda and mineral waters, it is important that the water to be charged should come in contact with carbonic acid in the form of a fine spray or a thin film in order that it may be thoroughly saturated. A German inventor, Mr. Jan Frederick Beins, aims to accomplish the desired result with the aid of a small air pump operated by a water motor. The water is spread out into a thin film by being forced through the unglaced porcelain walls of the chamber, and there it comes in contact with carbonic acid, which is held under small pressures. To obtain sufficient pressure to force the air through the pores of the porcelain, a simple form of compressor is used.

By increasing the air pressure from the usual standard of 70 lbs. to about 110 lbs., and introducing a pressure regulator attachment, the Westinghouse quick action brake has been converted into what is known as the Westinghouse high-speed brake. This provides for the automatic regulation of the shoe-brake pressure, beginning with comparatively heavy pressure at high speeds and reducing the same relatively as the speed slackens, with the idea that this is the most scientific and efficient way of stopping trains. The extended use of this device has shown results very gratifying to the manufacturers. They claim that its absolute reliability, a quality above all others requisite in brake apparatus, has been fully proven. A claim is also made that a train equipped with such brakes will stop in

about 30 per cent. less distance than that required for stopping a similar train under the old conditions.

The Science and Art of Mining, London, Eng., writes as follows:

"In all coal mines which are not free from possible mixtures which go to form an explosion, electric transmission in its present imperfect condition is hardly reliable; therefore, steam in the mine being out of the question, wherever hauling ropes are not applicable to advantage compressed air is an excellent servant, such as for coal cutting machines, pumps away in the workings, hauling beyond the effective limit of ropes. And to do the work to advantage, we should see to it that our air compressing appliances are right. The air compressors themselves should be equal to the highest possible call upon them, and the pipes for transmitting the compressed air should be large enough to do so at a linear velocity not exceeding 100 feet a second. By such means we avoid the terribly low efficiency that is too often obtained."

In a paper on the technical application of liquid air, read by Dr. Carl von Linden before the Cold Storage and Ice Association of London, Dr. von Linden expressed the opinion that liquid air cannot be spoken of to-day as a promising technical application of great importance, if there were no other property to consider beyond its low temperature.

In concluding his remarks he declared that the mistake had been recognized in regarding liquid air generally as "The Cold Storage Agent of the Future," "The Explosive of the Future" and "The Motor of the Future," but with due limitations he perceived in all these directions problems of greater and lesser importance, the solution of which, by liquid air, offers good prospects and appears worthy of the strenuous efforts of the engineer.

"Compressed air on tap" is not a novelty, but the idea of utilizing an ornamental railing as an air receiver is something which is decidedly new. Many of the employes of a factory at Dayton, O., use wheels in going to and from their work. Frequently the tires have to be "pumped up" and the management hit upon a plan which would save both time and labor.

Near the entrance to the factory several iron railings have been erected to protect ornamental grass plots which have been laid between the sidewalk and the street. A section of one of these railings has been connected with an air pump at the factory and a supply continually forced through the tubing. Three or four valves, attached to lengths of rubber hose, have been inserted in the railing, and when the cyclist wishes to harden his tire it is only necessary to attach the air hose and turn on the cog as he would the gas-jet in his room.

In the building of the new dam and power plant at Spier Falls on the Hudson River, by the Hudson River Water Power Company, an air compressor plant has been used with much success. This dam, which is built from Mt. McGregor to the Luzerne Mountains, is for the purpose of supplying electric power. It is expected that the generating plant will be ready for operation this summer and that the huge masonry dam will be completed within a year. With the increase in the price of coal last fall it was found that steam which had been used for power up to that time was very expensive, and a compressed air plant was established. The compressors are electrically driven with power from the Mechanicsville plant of the Hudson River Power Transmission Co. The plant consists of two 27 and 17 x 30" and one 14 and 22 x 16" duplex compound compressors driven by a General Electric synchronous motor when furnishing air at 80 lbs. pressure. The compressors are all rope driven. Eight inch main air lines lead to the various parts of the work from which the smaller lines are tapped and carried to the various pumps, hoisting engines, etc., which small line is provided with a reheating apparatus.

If an ordinary stud be screwed into a "blind" hole, there will be a certain amount of air trapped and compressed in the hole by the studs as it is forced in. Now, the pressure of this compressed air acting on the stud is liable to loosen it, and cases constantly occur of loose studs from this cause; to avoid this it has been suggested that a groove be cut along the threads so as to leave a small air passage

just below the threads; up this the air, or oil used for lubricating the tap, can pass. A similar thing takes place in case of covered nuts, so that it is possible to take similar steps to stop the action. In the case of small ones a groove up the screw as described would do, but in the case of large nuts, such, for instance, as are used for securing the propeller on the shaft of a screw steamer, a hole is usually drilled in the top of the nut, and a screw fitted to the hole to maintain the water-tightness of the cap. Where the bolt or shaft is horizontal it is better to have the hole near the edge, and, after tightening the nut up, to fill the hole with soapy water and replace the small screw. By having the hole at the edge it is evident that it can be turned up so as to be at the highest point for all the air to be driven out.

A blow-out of compressed air in the south heading, section B, of the Boston Subway Extension tunnel under Boston Harbor, on June 19, resulted in a cave-in that buried one or more men and injured several others. The tunnel passes under the harbor from Atlantic Street Station to East Boston. A shield was being used with an air pressure of 12 lbs. per sq. in., and, according to local newspaper reports, one of the workmen struck his pick into a seam of quicksand, whereupon the compressed air began to escape with a loud noise that was called an "explosion of compressed air." One of the inspectors who was in the shield at the time of the accident reported that during the first outburst the air escaped for about 10 seconds, then stopped for a second, then escaped for a minute, stopped again and finally escaped steadily for 15 minutes. Another inspector estimates the time of air outrush at about 5 minutes. The velocity of outgoing air was so great as to draw one workman into the earth where he was buried. The "explosion" has caused a depression in State street 10 ft. deep and 50 ft. square, and several buildings are leaning badly. Thirty men were in the drift at the time of the accident, and it is remarkable that more were not killed. The tunnel itself was not seriously injured.

Mr. Joseph Price, an English engineer, has recently devised and patented in England several changes in appliances for raising deep-seated waters by compressed air, particularly from deep-bored or artesian wells. The principal features of his invention are the substitution of a rising main, the area of which increases as the point of delivery is approached; the provision of an adjustable annular air ejector at the point where the compressed air is released; and the introduction of subsidiary or starting ejector at a high level when desirable.

The first of these, it is claimed by Mr. Price, permits the compressed air to expand freely in rising without increasing the velocity and consequently the application of the rising column of water. The ejector discharges the air at a high velocity which, it is said, induces an initial flow of the water overcoming its inertia and leaving thus less work for the power to do otherwise. The supplementary ejector, applied only when the lowering of the water level to obtain the supply has to be considerable, is used to effect a preliminary partial lowering, when it may be closed and the air allowed to issue from the lower ejector, thus avoiding the excessive pressure when the whole head has to be overcome at once.

Typewriter operators will be interested in learning of a new device that has recently been invented and patented by Jas. S. Parmenter, of Woodstock, Ont. The device consists of a pneumatic means of returning the carriage to the starting point after a line has been written.

By the use of this apparatus the work of shifting the sheet is transferred from the hands to the feet. The device consists essentially of a pneumatic cylinder supported on and secured to the carriage frame and having an arm extending against the end of the spacing lever or crank, a piston and hollow rod extending into the cylinder, an air pump suitably supported, preferably near the floor, underneath the typewriter desk, a tubular connection between such pump and the hollow rod extending into the cylinder and a sliding pedal having an operative connection to the piston of the pump.

At the end of each line it is necessary for the operator merely to push the sliding footrest away from him and the carriage at once passes across its bed and at the same time the spacer is acted upon

to push the copy further along and the work is then in position to commence a new line. With such a device as this it would not be necessary to remove the hands from the keyboard for any purpose and the speed of a writer would be considerably increased thereby.

COMMUNICATIONS.

Under this heading will be published inquiries addressed to the Editor of COMPRESSED AIR. We wish to encourage our readers in the practice of making inquiries and expressing opinions.

We request that the rules governing such correspondence will be observed, viz.: all communications should be written on one side of the paper only; they should be short and to the point.

Editor of COMPRESSED AIR:

In your May issue of COMPRESSED AIR I was pleased to see the prominence you have given our plant, with illustrations. I want to correct, however, your illustration No. 2, which you say is when the carpet is nearly cleaned. We do not handle carpets that way at all; in fact, the whole carpet is cleaned on the screen at the foot of the operator. On the table, where you see employed the man without the head, is wearing apparel being dusted by compressed air. We clean lots of women's skirts especially and do wonderful work.

The latest effort and success in the use of compressed air with us is the cleaning of horses. In this case we use air from 30 to 50 pounds pressure. The air is run through a brass coil of a National water tube heater, which is put into an old oil barrel. This pipe with the air in it is surrounded by water, which we heat with steam to boiling point, so in this way the air feels soothing instead of chilly to the horses. In applying it to the horse we have about a four-inch nozzle (a little pipe with a slit in it). We hold this in one hand and a common horse brush in the other, loosening the dirt with the brush and blowing it out with the air. We have eight horses with various dispositions, and while at first the noise and the hose, etc., makes them feel a little bit nervous, I think they are getting used to it and rather like it. It makes them slick and clean as can be; in fact, it gives them a silky appearance.

In addition to that we use the compressed air on all our machinery and in cleaning all our goods, bedding, etc., that we make before packing same for shipment. GEO. J. KINDEL, Proprietor,

Denver Compressed Air
Cleaning Works.

[Mr. Kindel has since written us to say that the cleaning of horses with compressed air has proven a complete success.—Ed.]

Editor of COMPRESSED AIR:

Mr. Kent in his "Mechanical Engineers' Pocket Book" quotes Mr. Kimball as saying: "When air is compressed, all the work which is done in the compression is converted into heat and shows itself in the rise in temperature of the compressed gas." Mr. Kimball then admits that the energy of cooled compressed air comes from the heat it had before compression.

Now if the heat of compression can be turned into power, then this power, plus the power that can be obtained from the cool compressed air, may more than equal the power required to compress the air: but if the losses have been so great as to leave no considerable surplus, then the exhaust air can be used to condense a liquid which the free air will evaporate and from the vapor more power can be obtained.

Carbon dioxide becomes a liquid at 890 lbs. pressure, 70 deg. F. The heat of compressed air can be used to evaporate this liquid and from the vapor power can be obtained. The carbon dioxide will have to be kept confined and used continuously.

Carbon dioxide can also be used in the other apparatus in which it is condensed by the exhaust air and vaporized by free air. From this vapor the third installment of power can be obtained. The free air used to evaporate this carbon dioxide becomes cold in passing through the vaporizer, and can be used to condense the carbon dioxide vaporized by compressed air. Trouble from the low temperature of the air exhaust can be avoided by using a compound engine.

Why cannot this whole apparatus be made so efficient that the surplus power will equal the power required to compress the air? Theoretically, nearly twice as much can be obtained.

JOHN M. WOODS.

INDEX.

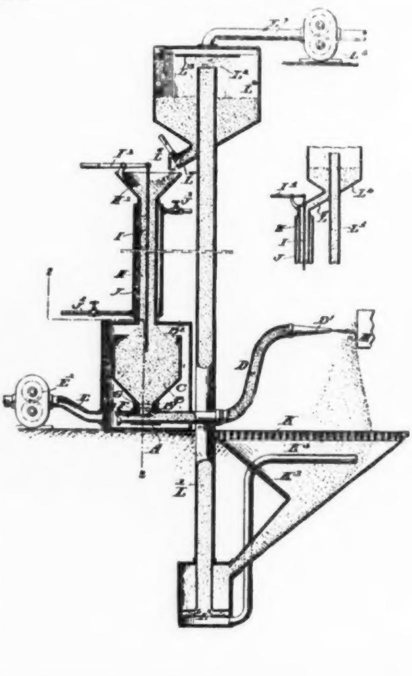
U. S. PATENTS GRANTED MAY, 1903.

Specially prepared for COMPRESSED AIR.

726,913. PNEUMATIC-ACTION FOR MUSICAL INSTRUMENTS. Frederick W. Hedgeland, Chicago, Ill., assignor to W. W. Kimball Company, Chicago, Ill., a Corporation of Illinois. Filed Sept. 3, 1901. Serial No. 74,066.

727,030. SAND-BLAST MACHINERY. Benjamin C. Tilghman, Jr., Philadelphia, Pa. Filed July 8, 1902. Serial No. 114,765.

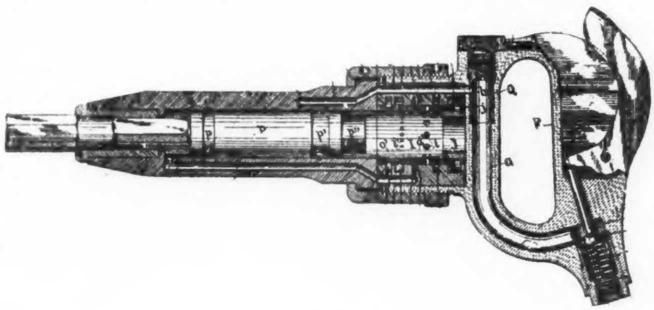
A sand-blast machine having a combining-chamber into which the sand and pressure fluid flow and mix and from which the mixed fluid and sand are led for use, said chamber having a passage for the entrance of sand, the combination therewith of a sand-feed conduit arranged to deliver sand to the said passage and in free communication with said chamber at is base, said feed-conduit being at the top free from the pressure in the combining-chamber and extending above its base connection with said chamber to a height which will give a sand-pressure at the chamber connection in excess of the fluid-pressure at the same point, and a restricted sand-blast nozzle through which the mixed sand and fluid issues from the chamber and by means of which the pressure in the chamber is maintained at a considerable degree above atmospheric pressure.



727,394. AIR-BRAKE. Joseph Lipkowski, Paris, France, assignor to Societe Generale des Freins Lipkowski, Paris, France. Filed Jan. 31, 1903. Serial No. 141,316.

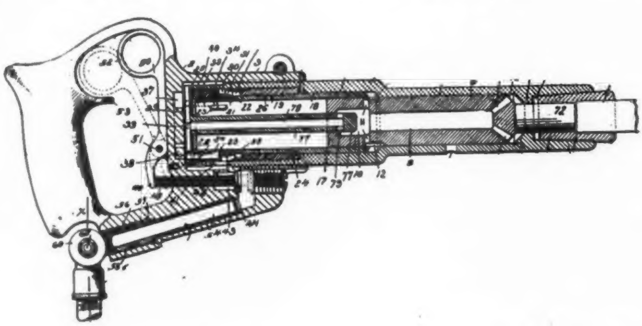
727,431. PNEUMATIC TOOL. Clarence W. Peck, Athens, Pa., assignor, by direct and mesne assignments, to Imperial Pneumatic Tool Company, Athens, Pa. Filed July 17, 1902. Serial No. 115,958.

An impact tool, the combination of a cylinder, a reciprocating piston therein, a cylindrical ported valve movable in line with the piston in a chamber at one end of the cylinder, and an enlargement on the valve travel-



ing in a separate chamber, to and from each side of which motive fluid is admitted and exhausted at each stroke of the piston to shift the valve.

727,954. PNEUMATIC HAMMER. Franklin M. Iler, Marion, Ohio. Filed June 17, 1901. Serial No. 64,794.



A fluid-pressure hammer comprising a cylinder or casing, a piston reciprocating therein, a sleeve-valve also reciprocating between the piston and the cylinder or casing and provided with a port, the cylinder or casing being provided with inlet and outlet ports with either of which said valve-ports may register, the sleeve valve closing one of said ports when the valve-port is in register with the other, the piston fitting within said sleeve-valve and being adapted to close its port and by compression ahead of it to exert a pressure on the valve tending to move it in one direction.

727,696. PNEUMATIC SPRING. Burrus L. Sanders, Dalton, Ga., assignor of five-eighths to A. B. Mason, Florence, Ala., and W. S. Sanders, Dalton, Ga. Filed Apr. 23, 1902. Serial No. 104,348.

728,068. PNEUMATIC PRUNING-SHEARS. Wesley Young, San Francisco, Cal. Filed Feb. 16, 1903. Serial No. 143,578.

728,084. ACID OR OTHER LIQUID DISTRIBUTING SYSTEM. William L. Colson, Savannah, Ga., assignor to Frank M. Wever, Savannah, Ga. Filed May 19, 1902. Serial No. 108,015.

An acid or other liquid distributing system, the combination with a compressed-air-supply pipe, an acid or other liquid transfer tank into which the compressed air is ad-

mitted through said pipe to force the liquid therefrom, of an air-vent communicating with the compressed-air-supply pipe, a valve automatically operated by the pressure of air to close the vent in said air-supply pipe when compressed air is admitted through said supply-pipe to the tank and to open said vent when the said air-pressure is cut off, and an acid or liquid supply tank or reservoir communicating with said tank.

728,069. PNEUMATIC PRUNING-SAW. Wesley Young, San Francisco, Cal. Filed Feb. 16, 1903. Serial No. 143,579.

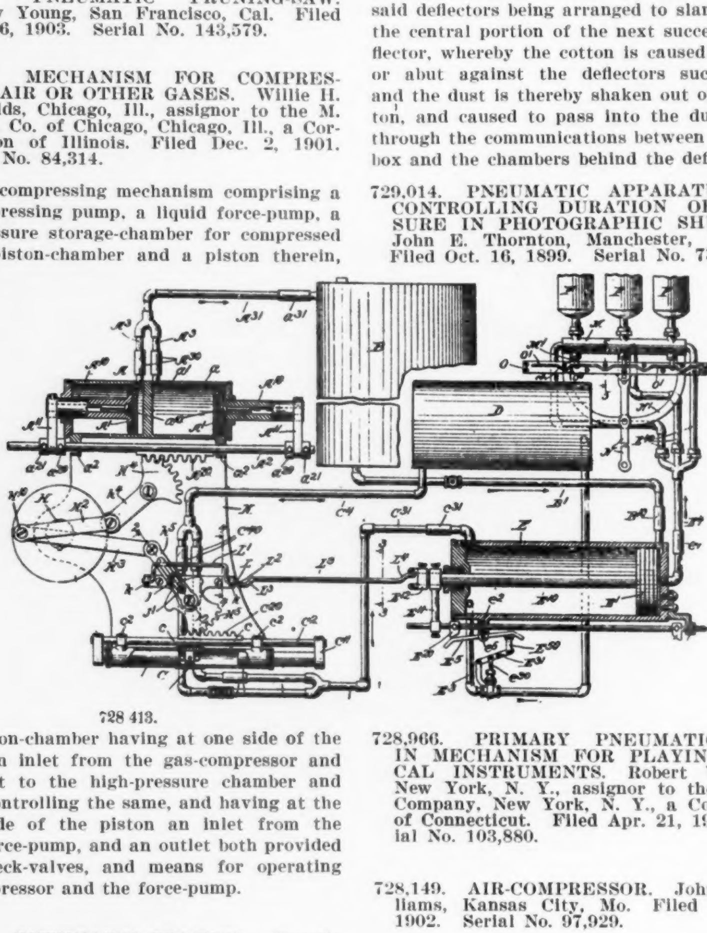
728,413. MECHANISM FOR COMPRESSING AIR OR OTHER GASES. Willie H. Reynolds, Chicago, Ill., assignor to the M. and P. Co. of Chicago, Chicago, Ill., a Corporation of Illinois. Filed Dec. 2, 1901. Serial No. 84,314.

A gas-compressing mechanism comprising a gas-compressing pump, a liquid force-pump, a high-pressure storage-chamber for compressed gas, a piston-chamber and a piston therein,

728,917. PNEUMATIC ELEVATOR FOR COTTON. John W. Hicks, Shreveport, La. Filed Mar. 3, 1902. Serial No. 96,527.

A pneumatic elevator for cotton comprising a separating-flue, a dust-box below it, a partition between the dust-box and the separating-flue, having a smooth surface over which the cotton passes, and a series of wire-cloth deflectors arranged in the flue, alternately, on opposite sides thereof, and having chambers behind them, communicating with the dust-box through openings in the partition, each of said deflectors being arranged to slant toward the central portion of the next succeeding deflector, whereby the cotton is caused to strike or abut against the deflectors successively, and the dust is thereby shaken out of the cotton, and caused to pass into the dust-trough through the communications between the dust-box and the chambers behind the deflectors.

729,014. PNEUMATIC APPARATUS FOR CONTROLLING DURATION OF EXPOSURE IN PHOTOGRAPHIC SHUTTERS. John E. Thornton, Manchester, England. Filed Oct. 16, 1899. Serial No. 733,789.



728 413.

said piston-chamber having at one side of the piston an inlet from the gas-compressor and an outlet to the high-pressure chamber and valves controlling the same, and having at the other side of the piston an inlet from the liquid force-pump, and an outlet both provided with check-valves, and means for operating the compressor and the force-pump.

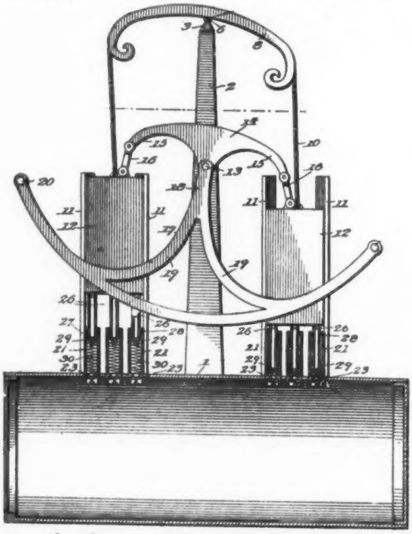
728,511. PNEUMATIC STACKER. Francis L. Stallard, Macy, Ind., assignor to the Indiana Manufacturing Company, Indianapolis, Ind., a Corporation of West Virginia. Filed Feb. 6, 1903. Serial No. 142,160.

728,966. PRIMARY PNEUMATIC-VALVE IN MECHANISM FOR PLAYING MUSICAL INSTRUMENTS. Robert W. Pain, New York, N. Y., assignor to the Aeolian Company, New York, N. Y., a Corporation of Connecticut. Filed Apr. 21, 1902. Serial No. 103,880.

728,149. AIR-COMPRESSOR. John C. Williams, Kansas City, Mo. Filed Mar. 12, 1902. Serial No. 97,929.

An air-compressor comprising a storage-cylinder, a plurality of air-compressing tubes connected to the cylinder, plungers co-operat-

ing with and movable through the upper ends of said compressing-tubes, said plungers having upper open ends, counterbalancing-weights



operating in connection with the plungers and contacting with the upper open ends of the latter, and operating mechanism attached to the said weights.